INTERNATIONL ARMAMENTS COOPERATION: A CASE STUDY OF THE F-16 AGILE FALCON CODEVELOPMENT PROGRAM

THESIS

Clay R. Frasier
Captain, USAF

AFIT/GSM/LSM/89S-9

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY
AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

AFIT/GSM/LSM/89S-9

INTERNATIONL ARMAMENTS COOPERATION: A CASE STUDY OF THE F-16 AGILE FALCON CODEVELOPMENT PROGRAM

THESIS

Clay R. Frasier
Captain, USAF

AFIT/GSM/LSM/89S-9

Approved for public release; distribution unlimited

The contents of the document are technically accurate, and no sensitive items, detrimental ideas, or deleterious information is contained therein. Furthermore, the views expressed in the document are those of the author and do not necessarily reflect the views of the School of Systems and Logistics, the Air University, the United States Air Force, or the Department of Defense.

AFIT/GSM/LSM/89S-9

INTERNATIONAL ARMAMENTS COOPERATION: A CASE STUDY OF THE F-16 AGILE FALCON CODEVELOPMENT PROGRAM

THESIS

Presented to the Faculty of the School of Systems and Logistics

of the Air Force Institute of Technology

Air University

in Partial Fulfillment of the

Requirements for the Degree of

Master of Science in Systems Management

Clay R. Frasier, B.S.

Captain, USAF

September 1989

Acknowledgments

First, I would like to thank my wife for her moral and typing support. I couldn't have done it without her. I would like to thank my daughter Sarah for going to bed without too much force when late nights were required. I would also like to thank all the people who cooperated in my research effort, especially Major General Robert Eaglet, Mr. Greg Schoettmer and Mr. Dwaine Mayfield. Finally, I would like to thank my thesis advisor, Dr. Craig M. Brandt, for his guidance and deft editing.

Table of Contents

Abstract

The purpose of this research was to examine armaments cooperation within the context of a case study of the F-16 Agile Falcon codevelopment program. The Agile Falcon program involved the U.S., Belgium, Denmark, Norway, and the Netherlands (original F-16 coproduction participants) in an effort to codevelop the next generation F-16.

The objective of the study was to answer nine investigative questions pertaining to the management, benefits, technology transfer, implementation, effects, and future of the F-16 Agile Falcon program. Additionally, the study provides an overview of armaments cooperation, and some previous lessons learned from applicable literature.

This research found that management problems expected during the codevelopment effort would have been reduced since the program was being set up similar to the F-16 coproduction program. However, problems related to system requirements, technology transfer/releasability, differing goals/objectives and differing laws and regulations could have caused management problems during execution of the program. Additionally, eight lessons learned were identified that would benefit management of the Agile Falcon program.

The U.S. could have gained a new aircraft, retained or increased jobs, and gained an aircraft to compete for the international fighter market. The EPGs could have gained a new aircraft, retained or

increased jobs, gained development expertise, and received advanced technology. The U.S. did not expect to receive much technology from the EPGs. The EPGs would have gained advanced avionics, airframe and engine development, and manufacturing technologies.

It is difficult to determine how much the EPGs would have participated in the management, technical development, and financial backing of the program. However, the invitation from the U.S. was there for the EPGs to take an active role.

It appears the Agile Falcon would have been a very good program for a codevelopment effort. The U.S. and EPGs have worked together, the management structure was in place, the development did not push technology, and the baseline aircraft is very capable.

The Agile Falcon certainly would have been a worthy competitor to the EFA, Rafale, and Grippen in the international fighter market. Cancellation of the program opens the international fighter market to the three European programs with no U.S. competitor.

The indecision within the U.S. over the aircraft's mission, lack of a European requirement, and the U.S.'s tight budget all contributed to the cancellation of the Agile Falcon program. Most likely codevelopment of weapon systems will be a future trend.

Recommendations included stable funding for international programs, improvement of technology transfer/releasability process, and increased training and documentation of lessons learned should be pursued.

INTERNATIONAL ARMAMENTS COOPERATION: A CASE STUDY OF THE F-16 AGILE FALCON CODEVELOPMENT PROGRAM

I. Introduction

General Issue

From 1984 to 1986, the Soviet Union produced 350 more fighters and fighter bombers than the member nations of the North Atlantic Treaty Organization (NATO). During that time the United States' defense spending was at an all-time high and the Soviets still managed to increase their numerical advantage of fighter aircraft over NATO (15:122). Each year NATO spends more money on defense and produces less equipment than the WARSAW pac (13:2-8). NATO spends more money and gets less equipment due to duplication in development and production of similar systems between members. Today, Germany, the U.K. and the U.S. are all continuing production of main battle tanks. Each country has borne the full development and overhead costs alone. In a similar matter, the U.S. is developing two new tactical aircraft (Advanced Tactical Fighter and Advanced Tactical Bomber), while France is developing the Rafale fighter and a European consortium is developing the Eurofighter. If all of the countries could have pooled their resources to develop two new aircraft, individual development costs would have been greatly reduced and large economies of scale could have

been achieved. The current and future political climate along with reduced military budgets will force the Department of Defense (DOD) to seek and implement cost saving methods of acquiring new weapon systems. Cooperation within NATO, and between the U.S. and other allies may become the only economical way to afford new high technology weapon systems required to offset NATO's numerical disadvantage.

Since 1974, Congress has encouraged cooperation by adding several armament collaboration amendments, but no money to defense authorizations and appropriations (13:2-19). In 1986, Congress amended the Fiscal Year DOD Authorization Act with the Nunn and Quayle amendments to stimulate and simplify cooperative weapon system acquisition between the U.S. and its NATO allies. The Nunn amendment made $200 million available to each of the services for cooperative research and development. The purpose of this Nunn money is to provide seed money to start cooperative development programs in the hope that it will increase the amount of cooperative research and development reducing redundant efforts between NATO nations. The Quayle amendment simplified implementing cooperative programs by "waiver of any provision of law, except the Arms Export Control Act, in formulation and regulating contracts" for cooperative projects jointly managed by the U.S. and a NATO ally. Under this amendment cooperative codevelopment programs are managed under section 27 of the Arms Export Control Act (13:2-8,9). Congress hopes to achieve weapon system cost savings, reduce NATO/Allied duplication, and increase NATO/Allied development and production capabilities.

With respect to NATO aircraft, NATO's air defense and air superiority aircraft are aging and may be unable to meet the threat in the late 1990s. The U.K., West Germany, Italy, and Spain are developing the European Fighter Aircraft (EFA) that the European consortium is convinced can fill their needs and capture a large portion of the international fighter market as well (11:30). At the same time the French are developing the Rafale which they hope can capture a large portion of the fighter market. Both the Rafale and the EFA are expensive, costing $50 and $55 million per aircraft respectively (32:17). In July 1987, the Secretary of Defense asked the Air Force and the Navy to examine upgrades of the F-16 and F-18 which could be codeveloped with NATO allies presumably to offer a cheaper ($15 to $20 million per aircraft) alternative to the Rafale and the EFA (3:22) General Dynamics proposed codevelopment of the next generation F-16 called the Agile Falcon. The U.S. solicited Belgium, Denmark, Norway and the Netherlands to codevelop and coproduce the next generation F-16 fighter aircraft (Agile Falcon) under the guidelines established by the Nunn and Quayle amendments (The same five countries have coproduced the F-16 since 1975).

Specific Issue and Justification

An international codevelopment program can be difficult to implement and manage (13:2-15). The Agile Falcon effort would have been one of the largest codevelopment programs undertaken by the U.S. However, the U.S. has never participated in, or led the codevelopment of, a fighter aircraft. The U.S. has participated in several successful

fighter aircraft coproduction efforts including the F-104, F-16 and AV-8A. Since Congress is encouraging cooperative weapon system acquisitions and it may be the trend in the future, a case study of the proposed F-16 Agile Falcon codevelopment/coproduction program could benefit the Agile Falcon System Program Office (SPO) and future cooperative programs.

Investigative Questions

The following investigative questions will guide the case study:

1. What management problems could be expected during the codevelopment effort of the Agile Falcon or of a similar program?
2. What lessons learned from other cooperative programs could benefit a future Agile Falcon program?
3. What could the U.S. and the European Participating Governments (EPGs) gain or lose with the codevelopment of the Agile Falcon?
4. What technologies could the U.S. and EPGs expect to gain from the codevelopment and coproduction of the Agile Falcon and what problems may be encountered?
5. To what extent would the EPGs participate in the management, technical development, and financial backing of the program?
6. Is the Agile Falcon the right program for a large codevelopment effort?
7. What effect would the Agile Falcon codevelopment effort have on other current European fighter aircraft codevelopment efforts?

8. Why was the Agile Falcon program cancelled?

9. Can codevelopment work for future weapon system acquisitions and will it be the trend in the future?

Scope

The research concentrated on the codevelopment aspects of the proposed and subsequently cancelled program. The F-16 coproduction program has been highly successful and the subject of previous research efforts. It is assumed that the coproduction of the Agile Falcon would have built upon the success of the previous/current F-16 coproduction efforts. However, some new and unique aspects of the proposed coproduction and the interaction of coproduction with codevelopment were revealed.

II. Methodology

Research Method

A case study of the Agile Falcon Program was conducted to answer the investigative questions. Primary data was obtained from published literature, unpublished program documentation, and interviews with program personnel. A literature review of armaments cooperation, technology transfer, codevelopment, and management of international programs was completed to form a basis for the case analysis. This was followed by a review of the Agile Falcon program documentation that existed prior to program termination (Contractor and SPO), current literature on the Agile Falcon, and current literature on similar cooperative programs. Interviews with U.S. government, European Participating Government (EPG), and contractor personnel provided information not available in the literature but which address the investigative questions. The interviews were administered to DOD, Hq USAF, F-16 SPO personnel, SPO EPG national representatives, and General Dynamics program management personnel. The judgement sample was intended to provide an insight into the management and expectations of the program. Interviews were conducted using an interview guide consisting of three sets of questions (see appendix B). The first set of questions replicated Bleakley's general questions and were general in nature with respect to armaments cooperation to ascertain the respondents views on the success, lessons learned, difficulties, results, benefits, and hindrances of NATO armaments cooperation (9:13-14, 121-122). The second set of questions focused on the Agile Falcon program. The final set of questions was summary in nature.

Research Sequence

The research was conducted in the following sequence:

1. Literature review of arms cooperation, technology transfer, codevelopment, and management of international programs
2. Literature and documentation (contractor's and SPO's) review of the Agile Falcon program supplemented by an informal interview with the Agile Falcon government program manager.
3. Literature review of similar aircraft and weapon system codevelopment programs.
4. Development of interview guides.
5. Interviews with program personnel.

Interview Process

Interviews were conducted in person where possible using the interview guide attached in appendix B. Interviews of government personnel in Washington D.C. and contractor personnel in Texas were conducted by phone. The questions were tailored to the applicable interviewees orientation (U.S., EPG, or contractor) during the interview. Additional questions were added if required to clarify and/or add information to the research.

Each interviewee was asked for his background in international programs and the particular role he played in the Agile Falcon program. General questions were asked per the interview guide to glean first hand

information on NATO armaments cooperation. Specific questions on the Agile Falcon program were asked to provide opinions and update information to further the research into cooperative programs. The summary questions served as a forum to conclude the interview from a "big picture" perspective.

III. Literature Review

Armaments Cooperation

Purpose. The purpose of international armament cooperation is to develop, produce, and employ interoperable weapon systems while sharing the associated costs (13:1-1). NATO leaders have tried for over 35 years to reduce duplication among Alliance participants (1:68). One of the major problems in the early 1980s hindering cooperation was uncertainty about the U.S.'s intentions coupled with contradictions between policies and actions which caused the European allies to be hesitant. The passing of the Quayle and Nunn amendments should send a clear message to the U.S. allies that Congress certainly supports armament cooperation. The pure economics, if nothing else, are forcing the U.S. to cooperate more than ever before. Charles Farr, in his 1985 PHD dissertation listed seven advantages and five disadvantages of cooperative projects:

Advantages

1. Opportunity for partners to trade off benefits to satisfy the needs of all participants.
2. Creation of jobs.
3. Opportunity to share program costs and risks.
4. Opportunity to expedite the future development of sophisticated technologies.
5. Alleviate supply bottlenecks, supplement the supply capacity of foreign partners, and improve the industrial infrastructure of the host country.
6. Strengthen political, military, and economic alliances in the free world; and lay foundations for future cooperation.
7. Reduce balance of payments.
(21:38-44)

Disadvantages

1. Technology exchange has been, and will (may) continue to be a one-way street.
2. Participation of inefficient subcontractors and the need to deal with complex organizational structures that can impair decision making may lead to unacceptable cost growth.
3. Need to harmonize fundamentally different management styles, budgeting processes, and government policy makes cooperative projects difficult to arrange initially, and also complicates management of the project once it is underway.
4. Some companies fear the creation of future competitors.
5. A sense of commitment and responsibility to foreign partners may prevent the timely recognition that a particular project is a loser and should be abandoned or redirected.
(21:42-44)

Codevelopment. Codevelopment is a type of cooperative program where contractors from two or more countries share the research and development of a system financed equitably by the participating countries. A "government-to-government memorandum of understanding (MOU) defines the terms and conditions of participation by the participating countries, and sometimes, their industries." (13:2-15). A codevelopment program is hard to implement due to problems transferring technology during early research and development, difficulties obtaining contractor's commitment of resources for speculative programs, and contractor's fear of losing business and proprietary information to competing contractors. Codevelopment offers the advantages of dividing the work and sharing the costs, management and development by top personnel, standardization and interoperability, and the "likelihood of obtaining the best technology through combined efforts" (13:2-15).

Coproduction. Coproduction is a type of cooperative program where contractors from two or more countries manufacture, fabricate, and/or assemble the system. Coproduction arrangements can be industry-to-industry or government-to-government. Coproduction is easier to manage and implement than codevelopment because the product is defined and documented (13:2-19). Coproduction can be fully integrated coproduction, production under a license, in a foreign country of a U.S. design, or production under license, in the U.S. of a foreign design. With fully integrated coproduction, the participants all buy the same systems and produce parts of each other's systems. With production under license, one or more countries produce their own systems under agreement with the original producer/designer.

Armaments Cooperation Background

Armaments cooperation and collaboration has been a goal of NATO since its beginnings in 1949. The purpose of early cooperative initiatives were to confront the growing Soviet threat while rebuilding the war torn industries of Western Europe. At this time some cooperation already existed. Both Germany and Holland were cooperating with Britain, producing military aircraft under license (29:9). In 1951, the NATO Military Agency for Standardization (MAS) was formed to "implement standardization, to enable NATO forces to cooperate in the most effective manner" (12:4). The MAS issues a Standardization Agreement (STANAG) to document an agreement on the use of similar military hardware and/or procedures when the particular standardization is approved by at least seven of the NATO nations (12:4, 13:15-24).

The STANAG approach has had some success in standardizing the NATO forces. The standard 7.62 mm round resulted from a STANAG. However, STANAGs had little effect on the standardization and interoperability of large weapon systems (12:4).

In 1959, new procedures were instituted to facilitate agreement of military requirements common to the NATO nations. This resulted in the NATO basic military requirement (NBMR).

> The lack of progress in procurement collaboration was ascribed to the absence of precise and fully defined military requirements among member states. If each were aware of the alliance's future military needs, so the reasoning went, each could plan national force structure in accord with overall NATO requirements (12:5).

NABR's were successful if the nation's individual needs matched the needs of the alliance. If this were the case, an agreement was usually reached and implemented. If the requirements did not match, agreements were difficult to attain and even harder to implement (12:5). In 1962, a review of the process determined that the NBMRs did not represent NATO's requirements from a strategical and tactical point of view (12:5). Not one of the 49 NBMRs developed between 1959 and 1966 resulted in a cooperative program (29:26-27). Under the NBMR strategy, aircraft developments became "promotional contests for national projects" (29:24). Up to this point in time, most NATO Rationalization, Standardization, and Interoperability (RSI) resulted from the U.S. supplying surplus or newly designed arms to the members of the alliance in FMS or assistance programs (9:24-26).

By 1960, the expansion of NATO armaments cooperation continued to be a failure. The failure was a direct result of the inability of the NATO members to agree upon requirements. Consequently, NATO abandoned the NABR procedures and established new procedures for cooperation between NATO members with as few as two participants. The participants would plan and structure the cooperative project and request that the project be designated a NATO project. NATO would only monitor progress and insure that other NATO nations were allowed to join the project at some later date "on reasonable and equitable terms" (12:5-6). NATO would have no authority to influence or intervene on the designated projects. NATO's role had evolved to provide a forum for armaments cooperation rather than initiating them among the member nations. Armaments cooperations continued to fail with cancellation of the French-British variable geometry wing fighter, U.S.- West Germany VSTOL fighter and the MBT-70 tank (12:6-7). However, a few European cooperative programs that started in the mid 1960s and produced aircraft in the 1970s were successful. The Jaguar, Tornado, and the Alpha Jet could all be termed successful cooperative programs (4:62,94,117).

The Conference of National Armaments Directors (CNAD) is the NATO body that provides the forum for cooperative armament requirements, solutions, and plans.

> CNAD acts as a clearinghouse for equipment proposals and has the capability to evaluate their technological feasibility, something which NBMR procedures failed to do sufficiently because proposals were largely by military personnel (12:7).

Between 1966 and 1971 few successes were realized forcing the CNAD to take a different approach in 1972. In 1972 the CNAD began to focus on specific programs hoping to improve interoperability and cooperation. Again, the CNAD achieved very little successes. At the same time, Eurogroup, an informal group of European NATO members, was formed and tried unsuccessfully to advance cooperation within the European community. Both the CNAD and Eurogroup have suffered from the political and industrial realities of armament cooperation. It is difficult to form cooperative agreements while maintaining individual political and industrial goals (12:7-8)

The U.S. Congress started to get serious in 1974 about armaments cooperation when the FY 1975 Department of Defense Authorization Act contained amendments supporting NATO RSI (13:2-1). Also, during this time the F-16 coproduction program was just beginning with formal agreement between the U.S. and EPGs in June 1975 (38:92). In 1977, the Buy American Act was waived for NATO cooperative programs with the passage of the Culver-Nunn Amendment to the FY77 DOD Authorization Act. Congress hoped that cooperative armament programs consisting of licensing and coproduction would result in increased RSI. It took until 1980 for DOD to document the Culver-Nunn Amendment in a DOD directive. The Culver amendment coupled with the previously mentioned Nunn and Quayle amendments serve as the foundation for U.S. policy on armament cooperation. With passage of the three amendments, Congress seemed ready to embrace and support cooperative armament programs.

According to the fifteenth annual report to Congress on the standardization of NATO equipment from the DOD, there is little cooperation among NATO members on major weapon systems. Defense News reported that the report cites a lack of cooperation in tanks, armored personnel carriers and tactical aircraft (40:56). The Germans continue with their Leopard series of tanks, the U.S. with their M1 series, and the British are developing the Challenger 2. With respect to armored personnel carriers, Congress forced the U.S. to compete a reconnaissance vehicle that the U.S. Army had planned to buy from Germany. A large portion of the U.S. and European defense development budgets are going towards the development of new tactical aircraft. The U.S. is developing the Advanced Tactical Fighter and the Advanced Tactical Aircraft; The U.K., Germany, Italy, and Spain are developing the European Fighter Aircraft; in the meantime, the Rafale is in development in France; and, the Grippen is in development in Sweden (40:56). Since new aircraft are not developed every year or even every five years, it appears that it will be sometime before there is another chance to have a large NATO codevelopment of an aircraft. According to Defense News, there will be possibilities to cooperate in the near future on armed helicopter programs and that "Standardization is greatest in the field of artillery pieces and rocket launchers, particularly since the introduction of the Multiple Launch Rocket System" (40:56).

Technology Transfer

DODD 2040.2 states:

> It shall be DOD policy to treat defense-related technology as a valuable, limited national resource, to be husbanded and invested in, in pursuit of National Security Objectives (14:2).

The U.S. protects advanced technology by restricting its availability and limiting its release to other countries. The U.S. invests in technology by conducting or sponsoring laboratory and development programs. In a codevelopment program, technology is invested in and shared between the partners. The U.S. has participated in many successful coproduction programs which resulted in the release of manufacturing technology to their partners. However, as mentioned before, the U.S. has not participated in very many high technology, codevelopment programs. As evidenced by the problems encountered by Japan's FSX program, some in the U.S. do not seem to be comfortable releasing development technology to the U.S.'s partners (24:2).

> Codevelopment -- as interpreted in Europe -- means that European firms will have an unencumbered share of the technological benefits of collaboration and not just a more equitable financial balance achieved either through offsets or production under license (12:32).

The U.S. is concerned about leaking high technology to Eastern Bloc countries and providing technology to friendly foreign industries that in the future may compete with U.S. industries.

It is this unencumbered share of technological benefits where the issue of technology transfer arises. The U.S. leads most countries in the development of advanced defense related technology. This lead allows the U.S. to counter the larger number of military systems the

Soviet Union and the Eastern Bloc deploy (13:8-1). The Soviet Union uses both overt and covert methods to obtain western technology to augment their own research and development (15:118). It is the fear of losing the new technology that has been transferred to Europe under a cooperative program that has hampered technology transfer from the U.S.

> The ability of the Soviet military-industrial complex to develop and deploy weapons with capabilities that often match or exceed their western counterparts, and yet are beyond generally assumed Soviet technological balance, is both impressive and ominous (15:120).

> Under the Reagan Administration the transfer of technology to friendly western nations was tightened to a point where it has begun to seriously impede the flow of US/European trade, and not in the area of Arms cooperation alone (47:27).

The main concern of the U.S. is that Europe maintains trade with Eastern Bloc countries; is close to or shares borders with Eastern Bloc countries making espionage easier; and does not have severe enough punishment for espionage related to illegal transfer of high technology (47:28). Dr. Stephen D. Bryen, Deputy Assistant Secretary of Defense for International Economic Trade and Security Policy in 1983, in an address to the Seventh Annual Executive Seminar on International Security Affairs alluded to the lack of security practiced by U.S. allies.

> The time has come, it seems to me, that American industry must talk to its counterparts in Europe and Japan and indicate to their colleagues the significance and importance to our mutual security of taking voluntary steps to protect these kinds of technology. In some countries, there is nothing that resembles industrial security (42:91).

The other main hindrance to technology transfer is industrial protectionism. There is considerable concern within the U.S. Government and industry over building up allied industry to a point where it becomes a serious competitor to U.S. industry (47:28). "Capital investments by the U.S. government and industry are extensive and it is understandable that this investment would first and foremost benefit the U.S. economy" (47:28-29). Opponents to the Japanese FSX program contend that the developmental and production technology transferred under the FSX program coupled with Japan's previous production experience with the F-4, F-15, P-3, and Boeing 767 will lead to a capability to produce military and commercial aircraft in direct competition with the U.S. (24:4-6). Congress has got into the act of protecting jobs, especially if the jobs are within particular constituencies hit hard by unemployment, by implementing legislature to protect the U.S. industrial base from foreign competitors (47:23). With respect to the FSX program the U.S. government is split. The Department of State and Defense support the program, while the Department of Commerce and trade representatives oppose it (24:4).

Intellectual property rights are the another main source of the disagreement (13:11-1). Intellectual Property under agreement within NATO includes:

> Inventions (patented or not), trademarks, industrial designs, copyrights, and technical information including software, data, designs, technical know-how, manufacturing information and know-how, techniques, technical data packages, manufacturing data packages, and trade secrets (13:11-1).

The definition of intellectual property does not differ much from technology. But, there is a difference between having a technology and being able to successfully implement it in a system or manufacturing process. Intellectual property and the right to use someone else's become the biggest issues when the transfer of technology in a cooperative program is negotiated. The DSMC Guide for the Management of Multinational Programs states:

> Specifically, as parties to the Memorandum of Understanding (governing a cooperative program), should ensure the availability of the intellectual property (IP) or intellectual property rights (IPR) that must be transferred, provide for their protection from misuse, or unauthorized dissemination when transferred, and guarantee fair compensation to the originator or initial holder of the IP or IPR being transferred (13:11-1).

Approval of technology transfer comes in the form of an export license with the U.S. Government or a U.S. industry as the licensor. Under the Arms Export Control Act, the State Department is solely responsible for approval/disapproval of export licenses. However, due to concerns over the U.S. industrial base, brought to light by the FSX Program and implemented under the 1987 Defense Authorization Act, the Commerce Department is to be consulted with by the DOD prior to recommending approval to the State Department military export license applications that could have commercial applications. Prior to that, the Defense Department alone made a recommendation to the State Department on export licenses for military applications. Currently, the President resolves all disputes between the involved agencies (5:24). Within the DOD, the Defense Technical Security Administration (DTSA) is the focal point "to ensure that international transfers of Defense

related technology, goods, services and munitions are consistent with U.S. foreign policy and national objectives" (46:2). The Office of the Under Secretary of Defense for Research and Engineering is responsible for providing DOD policy on technology transfer, technical support and recommendations and maintaining the Militarily Critical Technology List (MCTL) (46:3). The State Department maintains the International Traffic and Arms Regulations (ITAR). Within the ITAR there is a munitions list that includes twenty-two categories for which an export license is required (13:8-25). This munitions list and the MCTL determine what type of an export license is required and the State Department with recommendations from DOD, and now the Commerce Department, determines if approval should be approved (5:24).

Approval of technology transfer from the U.S. to its allies can be difficult and time consuming. In certain cases there are good reasons to disapprove technology transfer within a program. However, "it makes little sense to lock away technology, rather than share it with our allies" (47:29-28). If the U.S. does not share with its allies, the new technology may be duplicated by the allies, become obsolete before transfer is allowed, or "find its way into a Soviet system before it finds its way into a NATO or allied system" (47:29).

Management of Cooperative Programs

What makes some cooperative programs more successful than others? Farr, Ohmen and others have studied many specific determinants. Certainly there is no single answer to this question. However, a key element of many years of study is involved in all of the successes and

all of the failures: management. Managing a cooperative armament program is complex, difficult and dependent upon many variables including the management structure.

The participants in cooperative programs enter into the program with differing and sometimes conflicting goals and requirements. One view towards U.S. participation in cooperative programs is that the U.S. enters into them to develop and/or produce a highly capable weapon system at a cost less than procuring it alone (47:6). Lorell adds that the U.S. would like to increase NATO RSI, reduce the cost of research and development through less duplication and clever assignment of tasks to the partners, and "strengthen transatlantic NATO links" (29:72). Europe participates in cooperative programs to preserve jobs, improve their economy, gain technology, and (with less emphasis) promote NATO RSI (47:7). Lorell found that Europe wants to:

- Maintain diversified and broad based national R&D aerospace capabilities with restricted national defense budgets.
  - -- Reduce R&D costs for each participant to below the level of a national program.
  - -- Maintain or expand national employment levels or skills.
  - -- Acquire new technologies.
  - -- Encourage program stability
- Advance regional political objectives.
  - -- Contribute to the formation of a Franco-German Block.
  - -- Facilitate British entry into the Common Market.
  - -- Promote European solidarity.
- Counter U.S. aerospace competition.
  - -- Pool European industry for the development of aircraft to encourage European governments to buy European.
  - -- Combine European resources in development, production, and marketing to strengthen European sales worldwide (29:71-72).

Beside goal differences, each partner's system requirements may, and probably do differ. For instance, the U.S. has a requirement for worldwide deployment of their aircraft to fight a war. The Europeans prepare for war on their own turf (38:22). Thus, a basic requirement differs. Farr found that well defined and agreed upon requirements contributed to the successes of the Multiple Launch Rocket System, Seasparrow, F-16, and AWACS (21:124-128). Agreement upon the technical requirements within one country for a system is difficult by itself. Couple this with another country's technical requirements and different "big picture" goals and a tough management environment can be created.

A Memorandum of Understanding (MOU) is intended to provide guidelines already agreed upon to facilitate management of the program. The MOU documents formal agreement on goals and major requirements between the partners prior to the start of the program.

> It highlights and specifies what each participant must give up in terms of financing, technology, and sovereignty, and what they should receive in terms of end products, work shares, technology transfers and the like. The agreement usually addresses management structure, authority, payment procedures, conflict resolution policy and procedures (34:42).

The initial MOU agreement is critical since it guides the program and can have a direct bearing on program success. The MOU cannot be written to cover every contingency that might occur. However, major sources of conflict can be identified (34:42). While the MOU may reduce the complexity of the program in the future, the management problem of trying to get two or more parties to agree on an MOU's contents is

difficult and time consuming. The EPGs formed a consortium in early 1974 to find a replacement for their aging F-104s. It took over one year to finally agree to terms and sign the MOU to enter into the F-16 program (38:80,92). Within the DOD, the Undersecretary of Defense for Policy is required to "oversee the entire international negotiating process" (13:2-34). He can delegate responsibility to the heads of DOD components.

In the case of the Japanese FSX program, the Defense Security Assistance Agency (DSAA) signed the first FSX MOU in late 1987. This MOU left out key issues of technology transfer and workshare. This led to high level negotiations with the "final" agreement being signed by the Secretary of Defense. Then the President had to notify Congress under provisions of the Arms Export Control Act, and Congress became involved and forced further negotiation of the "final" MOU (24:2-4). Certainly in the case of the FSX codevelopment MOU, the process was complex and time consuming. As future cooperative partners increase their technological capabilities, concerns over technology transfer will make the MOU negotiation more difficult from a political point of view.

When two or more military organizations are involved with a cooperative program, the levels of decision makers increases with each level having its own goals and decision criteria to be satisfied. The MOU sets forth the management structure under which the cooperative program is managed. The structure of a cooperative program has additions not required for a unilateral development. DSMC defines three types of management alternatives for multinational programs:

Single-Country Managed Program Office. A single-country managed program office is sometimes referred to as a "pilot nation approach." Most multinational programs begin as single-country developments, such as the AV-8 Harrier. Many bilateral programs, especially small programs, are single-country managed to satisfy bilateral requirements. For the most part, these programs are structured and managed as they would be if they were single-country programs. The participating country may assign a liaison officer or representative to the program office, or it may simply monitor the program. Normally, the policies and procedures of the lead country dominate the program.

Multinationally Staffed Program Office. A multinationally staffed program is one in which the personnel from several participating countries work under one PM. The lead country provides the PM, most of the program management staff, and the administrative support. The participating countries each contribute a deputy PM and other military officers to the program management staff. This practice is becoming more common and seems to be the multinational program structure preferred by our North Atlantic Treaty Organization (NATO) allies for larger programs. The central program direction comes from a Multinational Steering Committee.

Multiple Program Office. A number of multinational Research and Development (R&D) programs are, in fact, multiple programs or projects whose activities are coordinated. The degree and method of coordination vary from program to program, as does the principal source of program direction. Frequently, a NATO subgroup plays a direct role in the program's execution. A participating nation may insist on forming its own program office for a program involving a large financial outlay, involving a complex development, or having a high degree of risk associated with it. The relationships between the national offices and the overall multinational program office would be detailed in an MOU and other coordinating documents. Central program direction comes from a multinational steering or control committee (13:9-2-9-4).

Most successful programs are governed by a steering committee (21:110, 34:132). "A relevant analogy to a steering group is the corporate board of directors" (21:51). Ideally, a steering committee

would have the authority to make large program decisions, hold regularly scheduled meetings, and capable representatives would be provided by the participating countries (21:51). Consequently, a program manager may receive direction from a steering committee and his own chain of command creating possible conflicts. Farr reported that:

> A steering group that has decision authority, meets regularly, and is staffed with competent people that would also be responsible for the program if it were purely a national effort, the group will be more likely to be successful than programs guided by present bureaucracies or other ad hoc organizations (21:109).

Farrel and Rauscher added additional substantiation to Farr's research by duplicating his conclusions(20:90, 37:67)

Farr found that:

> International cooperative programs guided by steering groups are more likely to be successful than programs guided by parent bureaucracies or other add hoc organizations (21:109).

Additionally, Farr found that: "International cooperative programs are more likely to succeed if the program is granted a high level of authority" (21:114). Ohman has stated similar conclusions.

Many other things complicate managing a cooperative program. Managers face difficulties in communicating with and between participants. Language, culture, physical separation, and management style contribute to communication problems (34:15). Management can be complicated by the size of the program. The initial F-16 coproduction program called for the purchase of 998 aircraft (650 - U.S., 348 - EPG). The responsibility for delivery of all the aircraft rested with General Dynamics and ultimately the F-16 SPO. The EPG industries did not assume any responsibility (44:3).

Cooperation of any kind is difficult. When two or more parties enter into a cooperative effort each side has its own goals, methods and character. Combining two or more sets of attributes to accomplish a common objective will always result in some sort of conflict. This happens within companies and organizations as well as in cooperative international programs. The difference is that within a single organization or company, a chain of command exists with a central authority to resolve disputes. In an international program, a single chain of command is usually not the case (34:1). A good MOU, while difficult to compose and negotiate, can reduce some conflict and contribute to the success of the program. Congruent goals and similar requirements, while not practically possible to achieve perfect harmonization, make a program easier to implement and manage. Clearly, a good steering committee providing guiding direction to a program manager with authority can facilitate the implementation of a cooperative program.

Problems and Lessons Learned (a Survey of Codevelopment Programs)

There have been many codevelopment efforts undertaken by the Europeans over the last twenty years. The U.S. is gaining more experience since cooperative programs have been emphasized within the Department of Defense, and the advent of commercial codevelopment programs within the private sector. In the literature, lessons learned and problems encountered have been documented for individual programs

and families of programs. Following is an attempt to summarize the problems encountered for a few different programs. At the end of this section, a list of lessons learned from the presented programs is presented.

Modular Standoff Weapon (MSOW). The MSOW is being developed by the U.S., United Kingdom, West Germany, Spain and Italy. The MSOW program is developing three variants of a cruise missile intended for long and short range standoff attack capability. It is intended that the missile will be carried by a large variety of NATO aircraft. There is no lead nation for the program; the U.S. is the host nation, meaning that U.S. contracting and administration will be utilized and the U.S. will host the international program office. The IPO is governed by the MSOW international steering committee and is not directly in the USAF's chain of command. Currently, the program is in Full Scale Development with initial operating capability in 1994. All of the participants contribute 22% of the development costs except Spain who contributes 12% and participate in work shares equal to their cost shares. The almost equal sharing of costs/work was implemented so that each partner would have an equal say in the program regardless of their projected buy (9:3, 74-79).

Following are some of the problems highlighted in Bleakley's research:

- Participating nations conducted redundant programs (9:77).

- Unrealistic cost and schedule estimates agreed upon prior to signature of the MOU created expectations that will not be meet (9:99).
- People who negotiated and authored the MOU did not understand the intricacies of contracting and program management in an international environment (9:100).
- U.S. personnel made commitments that had to be withdrawn because the U.S. positions were not adequately staffed or approved (9:108).
- Since workshare percentages are equal (except Spain) and not based upon projected buys some firms are reluctant to transfer technology (9:100)
- There is a large technology gap between participants, making the technology transfers difficult (9:98).
- Mistrust was created between participants because the U.S. is not willing to share some classified technology leading many partners to suspect classified duplication in the U.S. (9:98).
- The program has to satisfy a lot of different aircraft (10 or more) requirements (9:103).
- Two countries withdrew (France and Canada) because their work percentages were not commensurate with their cost contributions (9:101).

- Some chain of command and management problems surfaced since the program is truly internationally managed with no lead nation. The program is located at AFSCs Armament Division (AD), but not under their command (9:102).
- Some requirements disagreements over the MSOW's navigation system (terrain based or global positioning system) resulted in the system satisfying both and increasing the cost (9:102).

Boeing 767 Codevelopment. The Boeing 767 was codeveloped by the U.S., Japan, and Italy. Boeing a U.S. company lead the program contributing 70% of the cost/workshare with Japan and Italy contributing 15% each. The Japanese company (Japan Aircraft Development Corp) and the Italian company (Aertalia) can be generalized as risk sharing subcontractors. The program was considered highly successful with respect to cost, schedule, and technical performance (20:38-59).

Following are some of the problems highlighted by Farrell's research:

- Boeing Aircraft was used to designing aircraft under the traditional management concept of a central authority. The codevelopment effort required change by the top level management since the 767 program was managed by international committee (20:43).
- Since Boeing had the largest portion of the development, Boeing had trouble negotiating with their lesser partners because the partners were not sure if their interests would be fully appreciated (20:40-41).

- Graphical separation and language barriers hindered communication and control (20:43).

NATO Identification System (NIS) Mark 15 IFF Codevelopment. The NIS program is a codevelopment program between the U.S., France, West Germany, Italy, and the United Kingdom. The purpose is to develop common sub-components to be used in new identification of friend-or-foe systems under development among the participants to replace the current Mark 10 and Mark 12 systems. Under this program no one system is being developed for common use and the costs of the program are not shared (27:50). This makes the program certainly a cooperative one, but raises questions about whether it is a true codevelopment program. Under codevelopment programs the development cost are shared and usually one system is developed. The program has been on going for over 20 years with the U.S. involvement since 1980. Over 200 million dollars have been expended (27:40-41).

Following are some of the problems the program has identified in Hepner's research:

- Since each country is pursuing its own major system, each has a project director most likely limiting the cooperative aspects of the program.
- A major requirements disagreement added testing that increased the time and cost of the program with the end result being a compromise using both of the conflicting requirements. It is estimated this increased the cost of the U.S. program by 20% (27:50-52).

- Geographical and language differences caused communications problems (27:50).
- Ratification of a NATO standard (STANAG) on identification systems was delayed due to the requirements problems (27:61).

Berguet 1150 Atlantic Patrol Aircraft Codevelopment. The Atlantic Anti-Submarine Warfare (ASW) aircraft was conceived in the late 1950s as a cooperative development of an aircraft to replace the Lockheed Neptune (P-2) aircraft. Originally fourteen nations agreed upon the requirement and timing of the program. However, at the start of the aircraft development program only France, Great Britain, Holland, Germany and the U.S. participated. During this time the Europeans perceived that the U.S. was pushing U.S. developed systems as a means to meet NATO RSI initiatives. The result was a distrust of American goals by the UK and France. Consequently, the NATO steering group excluded U.S. aerospace companies from entering a design in the Atlantic design competition. A French aircraft, the Brequet 1150 was chosen with the political considerations as important as the technical ones. After selection of the French aircraft, Great Britain dropped out since one of their industry's aircraft was not chosen (29:13-26).

A key to the program was that all of the participants agreed upon the requirements, timing, and the aircraft development did not push or include state of the art technology. The U.S. and France were the major financial contributors with Holland and Germany picking up the slack. France led the program and on two occasions funded it unilaterally until the consortium worked out the funding issues. The development program

was marginally acceptable due to the efforts of France's sometimes, nationalistic leadership. The production phase of the program could be termed unsuccessful since only two NATO countries procured 87 out of the projected total of 300 aircraft. Additionally, the U.S., Great Britain, and Canada developed competing aircraft, forgoing purchase of the Atlantic (29:13-26).

Following are some of the problems highlighted by Lorell's research:

- Funding problems among the participants allowed France to take the lead of the program instilling its own national objectives (29:12,22-23).
- Political problems developed between partners as a result of decisions made on other cooperative programs. (Germany's decision to produce the F-104 under license rather than procure a French design) (29:28).
- The program overestimated the number of aircraft that would be purchased because early participants did not have to commit to aircraft up front (29:18).
- The U.S. pushed the Atlantic's program development and funded a major portion of it for the sake of having a NATO cooperative program while developing a competitive aircraft (29:18,24-25).
- Fourteen nations agreed upon joint requirements, six nations committed to buy aircraft, five nations funded the program and only two nations bought aircraft (France and Germany) (29:28).

Transall C-160 Military Transport Codevelopment. The Transall C-160 military transport aircraft originally was to have been developed by France, Germany, and Italy. The French wanted an aircraft, similar to the U.S. C-130A, that had long range endurance capabilities, large payload capabilities, and could operate in a desert environment. The Germans and Italians had requirements for a medium range short takeoff and landing aircraft. Early on in the program, Italy dropped out leaving the program to France and Germany. The program was initiated in 1958 with initial deliveries of the aircraft beginning in 1968. "The French policies of promoting extensive design capabilities and maintaining employment" drove the French to develop a new aircraft rather than procure the C-130A (29:32). Neither Germany's nor France's requirements were completely satisfied. Lorell reports that the "Germans did most of the compromising" (29:32). The program resulted in an aircraft that did not meet performance expectations, experienced a 100% cost growth, and took twice as long to develop and produce than originally estimated (29:31-46).

Following are some of the problems revealed by Lorell:

- Requirements disagreements resulted in an aircraft "that was a compromise between diametrically opposed mission concepts" (29:46).
- Politics played a major role tying the program to French and German relations. "Germany traded off military requirements in return for technology acquisition" (29:34).
- The project was managed by an "equal bilateral management structure" that resulted in a lack of central decision making authority within both the governmental and industrial teams (29:35,46).

- The two partners did not structure the program to take advantage of each of their capabilities. "Key economic considerations at stake were employment and national aerospace capabilities rather than the exploitation of relative economic advantage or the rational pooling of R&D capabilities" (29:46).

The Panavia Tornado Multi-Role Combat Aircraft Codevelopment. In 1965 France and the UK signed a Memorandum of Agreement to codevelop a jet trainer and a variable geometry frontline fighter. The jet trainer development resulted in the Jaguar. However, France withdrew from the fighter program due to budget considerations. From 1967 to 1968 the Netherlands, Belgium, Italy, Germany, the UK and Canada participated in meetings to agree upon requirements for a multi-purpose fighter. Eventually, the Netherlands, Belgium and Canada withdrew leaving the UK, Germany and Italy. In late 1968 and 1969 the UK, Germany and Italy put together an international consortium, named Panavia, to develop the Tornado, a Multi-Role Combat Aircraft (MRCA). The international consortium was staffed and owned by the British Aircraft Corporation (42.5%), Messerschmitt Boelkow Blohm (42.5%) and Aeritalia (15%). To manage the consortium, the participating governments put together a high level committee of government officials, called the NATO MRCA Management Organization (NAMMO) to monitor the work of Panavia and the subcontractors. NAMMO organized a lower multinational agency called the NATO MRCA Management Agency (NAMMA) to oversee the day to day operations of Panavia. Early on in the program the participating governments agreed "that decisions made at the government level would be made

unanimously" (41:98). The program experienced some cost escalations and schedule slippages. However, over 800 aircraft have been produced including those for two FMS sales to Saudi Arabia. Interestingly, the Government committees (NAMMO and NAMMA) and the Panavia Consortium were revised for the Saudi Arabian sale. Saudi Arabia contracted with the UK for the aircraft who in turn contracted with British Aerospace Corporation. Messerschmitt and Aeritalia served as sub-contractors to British Aerospace for the Saudi program (41:94-110).

Following are some problems identified by Spreen:

- Political factors contributed to the "inherently unwiedly managerial process" (41:105). All of the nations wanted their industries to win the contracts with the largest amount of technology and labor hours (41:165).
- Original work share percentages were hard to attain and maintain and had to be renegotiated (41:107).
- The governments divided development and production costs "in ways that were intrinsically expensive" (41:98). "For example, the governments designated the firms that were to participate in the program. Competition among vendors resulted in contract awards for major subcontracts, but the consortium was often required to provide smaller contracts to firms that had been unsuccessful in the principle competition" (41:98).

- Management by committee and complexity of the industrial and governmental management organizations made the process of decision making more difficult and time consuming (41:100,104). For example, "all of the purchasing decisions had to be reached unanimously by the member firms of Panavia and members of NAMMA" (41:104).
- Cost increases caused budgetary problems in Germany resulting in cancellation of other German military programs so they could still back the Tornado. If participants want to subsidize their industries, details and cost consequences need to be detailed upfront in the program.

Lessons Learned. Following are some lessons learned derived from the problems listed above.

- Provide long term and consistent funding for international cooperative programs. (Atlantic, Tornado)
- Firm commitments for aircraft should be generated if possible to enable economic sizing/trade-offs of the program upfront. Multinational development and production of aircraft not procured in economical quantities defeats the purpose of coproduction. (Atlantic)
- It does not make sense to enter into a cooperative program for political reasons at the expense of military requirements just to participate in a cooperative program. (Transall, Atlantic)
- At the outset of a cooperative program, requirements should be compromised and agreed upon to the extent that the negotiated requirements will still satisfy each participants overall

requirement. Agreeing to a system that serves a "diametrically opposed mission" could result in less military support and subsequent funding problems. (Transall)

- Insure that all partners agree with the program's requirements prior to program implementation. (NIS, MSOW, Transall, Tornado)
- Just because the participants' requirements and timing for a cooperative program match, do not expect the program to be conflict free. Nationalistic conflicts were the major reason the Atlantic was not procured by more nations. (Atlantic)
- Do not agree to cost and schedule figures unless the program's requirements have been defined and agreed upon by all of the partners. (MSOW)
- Use the lead nation strategy to facilitate program management through central leadership. (MSOW, Boeing 767, Transall, Tornado)
- Divide the work and responsibilities between the cooperating industries in the most economical way or be prepared to increase the program's cost. (Tornado, Transall)
- Workshare percentages should be commensurate with cost contributions and not be deterministic. They should be goals attained to the maximum extent possible. (Tornado, MSOW)
- Insure that cooperating nations do not conduct redundant programs at the same time they are participating in a cooperative program. This will help to make sure that each participant is committed to the program. (Transall, MSOW)

- Staff international program offices with personnel experienced in international programs. (MSOW)
- Try to participate with countries that have similar technological capabilities to facilitate technology transfer in more than one way or accept the fact that technology transfer will be one way when one partner has more advanced technological capabilities than the others. (MSOW)

IV. F-16 Agile Falcon Program

Background

In 1974, the General Dynamics' F-16 won the light-weight fighter competition (25:38). Since 1978, over 2300 F-16 aircraft have been coproduced; by 1991, over 2500 will have been coproduced (44:1). The F-16 program has been one of the most successful coproduction efforts the U.S. has participated in to date. There are final assembly lines in the U.S., Belgium, the Netherlands, and Turkey. The U.S., Belgium, Denmark, Norway, and the Netherlands were the original partners in the F-16A/B program and have been coproducing F-16's since 1975 (33:214). The EPGs purchased F-16 A/Bs while the U.S. purchased F-16A/Bs and the newer F-16C/Ds. The EPGs require a new aircraft and/or an F-16A/B update to meet the threat in the late 1990s and beyond. The USAF requires a new fighter to supplement the Advanced Tactical Fighter (ATF) in the same way the F-16 has augmented/complemented the F-15.

Agile Falcon

In July 1987, General Dynamics submitted an unsolicited proposal to the Air Force to codevelop the next variant of the F-16 (Agile Falcon) with the four original EPG's hoping to capitalize on a new Belgian requirement for a new fighter aircraft (36:23). Subsequently, the Secretary of Defense instructed the Air Force to pursue upgrades of the F-16 to meet future threats and compete against current European aircraft under development for the international fighter market (35:21-22). After that, the Pentagon approved the predevelopment plan

and a memorandum of understanding was under review for signature (32:17). If the codevelopment effort were implemented, plans were to coproduce the Agile Falcon similarly to the current program. The Agile Falcon would have been a strong competitor with the European Fighter Aircraft (EFA) and the French Rafale for the foreign fighter market. The EPGs viewed the Agile Falcon as a cheaper alternative to the EFA and the Rafale (32:17). Currently, the Agile Falcon is undergoing predevelopment (concept exploration) with completion of this phase in December 1989. Over five hundred F-16 Agile Falcons could have been produced beginning in the mid 1990s for the U.S. (500), EPGs (200), and FMS customers (36:23).

The Secretary of Defense's instruction to pursue upgrades of the F-16 to meet future threats evolved the Agile Falcon program into the F-16 Derivative Aircraft program which consisted of two codevelopment programs. The first was the development of a new F-16 (F-16 Derivative Aircraft, called the Agile Falcon) and the other is the development of a mid-life update (MLU) for the F-16A/Bs. The MLU program came to life when the EPGs were willing to participate in the codevelopment of the new aircraft but were unwilling to commit to new aircraft purchases. However, they were willing to commit to upgrades to their existing F-16A/Bs (39:1). Both programs were collectively called the F-16 Derivative program. The F-16 Derivative Aircraft was to be the next generation F-16 while the MLU program will update the F-16A/Bs with F-16 Derivative Aircraft avionics (to the maximum extent possible). As proposed under the auspices of the Agile Falcon program, the Derivative

Aircraft program was a codevelopment effort between the U.S. and EPGs consisting of three phases: 1) predevelopment, 2) development (Full scale engineering development) and 3) production. According to the proposed MOU:

> ... the partners will seek an optimum mix of combat effectiveness, technical, cost, schedule, commonality, and industrial participation factors (2:11).

The F-16 Derivative Program Office (DPO) estimated that the total development (pre-development and FSED) would have cost about one billion dollars with production beginning in late 1994 or early 1995 for both the new aircraft and the update kits (39:1).

Predevelopment

The purpose of the predevelopment phase is to identify and limit configurations for further investigation in the development phase. Under the Memorandum of Understanding covering the current F-16 coproduction program, the U.S. and the EPGs agreed to explore the feasibility of the F-16 Derivative program. This is being conducted under a clause in the current F-16 coproduction MOU that "states that participating governments acknowledge the need for continuing engineering programs throughout the life of the F-16 program" (18:1). This decision is documented in the F-16 Multinational Program Steering Committee Arrangement number 44. The USAF used this arrangement as a signed MOU to qualify the program as a Nunn candidate program to receive Nunn funding (39:1). This arrangement provides no strict guidelines for codevelopment in the predevelopment phase. It calls for the European Participating Industries (EPI) to participate to the "maximum extent

possible" during the predevelopment phase (18:2). The governments agreed on a not-to-exceed cost of 12.5 million dollars. The cost sharing arrangements for this phase are based on the number of "F-16A/B aircraft purchased minus attrition" (18:2). Following are the cost share percentages: U.S. 60.24%, Belgium 12.04%, Denmark 5.31%, The Netherlands 16.68%, and Norway 5.73%. The EPGs will pay for the predevelopment under the current EPG Letters of Acceptance (LOAs) governed by the current F-16 coproduction MOU and there is no provision for recoupment of development costs under the F-16 Multinational Steering Committee arrangement (18:2). Additionally, technology transfer under this phase can only be applied to support the F-16 Derivative Aircraft program or future F-16 programs.

> Technical data, information, and documentation produced by this cooperative predevelopment program may be used by any of the government or industry participants, in so far as they have rights, only to further F-16 development and production, unless approved in writing by the participating governments (18:3).

The steering committee arrangement limited the requirements for true codevelopment and technology transfer in the predevelopment phase. This allowed the program to get started while the details of the large codevelopment effort and technology transfer for the development and production phases could be negotiated between the participating governments. This was possible because a multinational governing body already existed for the F-16 program. During this phase, up to 100 people from EPG industries were collocated at General Dynamics to participate in this phase (39:1).

Development (Full Scale Engineering Development - FSED)

The purpose of the development phase is to design, develop, manufacture and test prototypes leading to the final design of the F-16 Derivative Aircraft and mid-life update kit. An entirely new contract would have been let to General Dynamics to accomplish this phase. For the first time on an F-16 program, production data packages would be delivered to help further competition during the production phase allowing a leader follower development and early production followed by competitive subcontracting. The FSED and the production phases were to be governed by a new Memorandum of Understanding between the U.S. and the EPGs. This MOU would govern the development, production, procurement and support of an F-16 Derivative Aircraft and F-16 mid-life update kit (2:11-13). The proposed MOU names General Dynamics as the prime contractor responsible for system integration. Under the proposed MOU, a steering committee consisting of one principal and an alternate member from each nation would direct the F-16 Derivative Program Office as needed to successfully accomplish the program. The steering committee "will be responsible for broad policy matters, advice and counsel to the Lead Nation, and recommendations to amend" the Memorandum of Understanding (2:16). Each member of the committee has one vote. Decisions requiring large financial outlays require unanimous decisions (2:16). The U.S. government, as the designated lead nation, would manage the F-16 Derivative Fighter Program Office (DPO), administer and award contracts, and be the final arbitrator for conflicts unresolvable by the Steering Committee (2:17,20). To foster competition in the

production phase, the development program would use a European Participating Industry (EPI)/U.S. Participating Industry (USPI) development team concept. Current plans call for a U.S. and an EPG company to cooperate, with one company leading, during the full scale engineering development phase, then split, and compete during production. The production contracts would be awarded in a split fashion similar to the current USAF engine contracts (for example a 60%/40% mix). The current MOU does not specify a work/cost share arrangement during the development phase. The proposed MOU directs the program to maximize industry participation among partners. However, the development work will be divided according to the participants industrial capability and the amount of funds provided for the development effort. If a country elects not to contribute to the FSED, they would not participate in that phase of development but would be allowed to reenter the program during production if they buy aircraft or MLU kits (2:41).

Production

The current proposed MOU does not include any specifics concerning production. Prior to the production phase, the steering committee would update the MOU to include the guidelines for the coproduction effort. The production would be cooperative with only those participants buying aircraft or MLU kits participating in the production. Additionally, the participants would only be able to produce parts for what they buy. If the U.S. buys only new aircraft, they cannot participate in the

coproduction of the MLU kits. Since the U.S. and EPGs have a great amount of experience and an excellent track record in coproduction of the F-16, problems would be few and the production phase should be highly successful.

Follow-on Support

Interestingly, the proposed MOU did not plan to address follow-on support and never would. With input from Ogden Air Logistics Center, Headquarters USAF decided that current Foreign Military Sales procedures were better suited to Follow-on support (2:48).

Derivative Program Office

The Derivative Program Office (DPO) is managed by the USAF Air Force Systems Command (AFSC) F-16 System Program at the Aeronautical Systems Division (ASD). The DPO program manager works directly for the director of the F-16 SPO due to the high visibility of the program. A foreign national representative from each of the EPGs is located at the F-16 SPO and represents their respective countries on day-to-day matters. Currently, the project team is small consisting of less than twenty people supporting the program.

Current Status

The U.S. cancelled the Agile Falcon program by deciding not to fund the program past the predevelopment phase. The predevelopment of the Derivative Aircraft Program (Agile Falcon) concludes in December 1989. Paper studies including wind tunnel test data of the proposed configuration will be delivered to the USAF. However, the Mid-Life

Update program will continue with 75% of the kits procured intended for the EPGs with delivery beginning in 1996. During Agile Falcon negotiations with EPGs, the U.S. turned down proposals from Korea, Turkey, and Israel to participate in the Agile Falcon codevelopment program (39:1). Defense News reported on 5 June 1989 that DOD is interested in bringing the Agile Falcon back to life sometime in the future under the Japanese/U.S. FSX codevelopment program. The two aircraft designs are very similar with both incorporating a large wing. It is possible an Agile Falcon/FSX hybrid could become the Block 80 F-16 configuration (4:1).

V. Findings

In this chapter, responses to the interview questions are presented. The responses are put into context to address the nine investigative questions listed in chapter I. First, additional background information obtained from the interviews is presented followed by the information obtained from the interviews that is relevant to the research questions.

According to Roy Hempley, Staff Analyst for the Office of the Assistant Secretary for Defense, the Agile Falcon program was started in part when Japan challenged the U.S. to show an aircraft in development that could meet Japan's needs when the U.S. was pressuring Japan to buy a U.S. developed aircraft. At that time the Air Force and Navy were directed to examine derivatives of the F-16 and F-18 for a possible codevelopment effort with the Europeans. At the same time, General Dynamics had conceived the Agile Falcon program to bring back the original F-16's maneuverability lost to weight increases over the years. Thus, the Agile Falcon program, later renamed the F-16 Derivative Aircraft program began (26:4). "The Agile Falcon program did not start with a military requirement. Industry coercion and pushing plus the Japanese discussions led to the idea of the Agile Falcon" (26:4).

As mentioned in Chapter 4, the U.S. and Europeans began development under the current F-16 coproduction MOU and began discussions on a new

codevelopment MOU for the F-16 Derivative Aircraft program. When the U.S. had trouble gaining the support of the EPGs, the mid-life update of the EPG/U.S. F-16A/Bs was tied to the Derivative Aircraft Program (39:1).

Expected Management Problems

Many management problems could be encountered during a codevelopment effort like the Agile Falcon. Some of the potential problems could be similar to those addressed in the literature. Those interviewed thought that requirements, laws and regulations, technology transfer and releasability, work share arrangement, and a few other issues would present some problems during program execution.

Usually, military requirements start with a threat. Colonel Ralph Bacue, Director F-16 International Programs, and Lt Colonel Terry Tomeny, SAF F-16 Deputy for International Programs, think the Europeans are not perceiving the same threat as the U.S., certainly making it harder to reach an agreement on requirements (6:1,43:1). A key to agreeing upon requirements, is the MOU. Getting an MOU agreed upon is one of the most difficult aspects of an international program (22:1).

> The EPGs are four different political animals. From the political aspect, unanimity is almost impossible. The shear task of getting four independent cultures to come together on a common program is difficult (31:2).

Mr. Hempley adds that "NATO is not a country or a political entity that can respond unilaterally" (26:1). From the technical standpoint, it becomes very difficult to merge multiple requirements and build a system that will satisfy all of the participants (10:1). Major General

Eaglet, former F-16 Program Director, adds that the U.S. is less likely to compromise than the Europeans adding further complications to the cooperative requirements process (17:1).

Since a military requirement did not drive the initiation of the Agile Falcon program, problems defining requirements were encountered. Currently, the Air Force has a large need for a Close Air Support (CAS) and Battle Field Air Interdiction (BAI) aircraft. The Air Force would have liked the Agile Falcon to fill the CAS/BAI mission. The Europeans preferred a multi-role aircraft with an emphasis on air-to-air capabilities (26:4). Similarly, the DOD wanted a multi-role aircraft to complement the ATF in the air-to-air role (23:4). The requirement differences were clear when the Deputy Secretary of Defense directed that the Agile Falcon should be developed to complement the ATF, primarily in an air-to-air role with multi-role capabilities (26:4). "There were actually some moves within OSD to use the Agile Falcon as a cheap replacement for the ATF" (19:4). While the U.S. had a problem agreeing upon a military requirement for the Agile Falcon, the U.S. could not convince the Europeans that they had a requirement for the Agile Falcon. The EPGs do not see the same threat as the U.S. and their planning does not go as far out into the future as the U.S.'s, adding more difficulty to the requirements agreement process (30:4).

All four EPG representatives thought that the U.S. acquisition laws and regulations were very difficult when implementing cooperative programs. The Arms Export Control Act was blamed for its inflexibility and vagueness (8:2, 28:1). Major Vatn stated that "the Europeans

put their laws away when negotiating a cooperative program, while the U.S. falls on their laws" (45:2). Mr. Greg Schoettmer, Air Force Agile Falcon Program Manager, found the Arms Export Control Act inflexible and directive, making negotiations from the U.S. perspective tough (39:2). Also, the U.S. insists that there is at least one source of a particular component in the U.S. From the European perspective, this rule automatically increases competition with their industries (8:2). Additionally, customs duties and taxes makes it difficult to transport equipment and subsystems between partners adding further difficulty to the process (19:2).

Mr. Mayfield, Agile Falcon Program Manager and Mr. Durando, Agile Falcon Business Manger of General Dynamics listed technology transfer and releasability as the major hindrance to successful armaments cooperation. It is time consuming to gain releasability approval and approval of export licenses. Mr. Mayfield believes indecision concerning releasability after so-called program approval sends mixed signals across the Atlantic about the U.S.'s intentions. He also adds that the General Dynamics staff spent an inordinate amount of time trying to gain releasability approval and approval of export licenses (31:24, 16:2).

> Within the Government there does not seem to be a real ownership of the problem. It falls back on the contractor and at six o'clock in the evening when the contractor is trying to meet schedules, the U.S. Government is not around. If we are going to do true cooperative efforts, we need to get our shit together and make it easier to obtain an export license. There are too many people in the decision process who can slow it down or say no. Now the Commerce Department wants a piece of the action (31:2,5).

Mr. Brailey, F-16 Technical Director, notes that technology transfer issues, as expected, are most difficult early on in a program and eventually the systems or technologies in question are released (10:2). Colonel Kennis, Belgian Senior National Representative, states a similar concern. "It is not the lack of being able to get the technology or system, it is the time consuming administrative process of approval that hinders a program" (28:2). Maj General Eaglet adds that this slow releasability process adds time and risk to the program (17:1). Dean Gissendanner, an OSD staff analyst, is not sure that technology transfer hinders cooperation, but agrees this perception is prevalent in Europe (23:1).

Today foreign partners, as a prerequisite to join a program, demand larger and larger workshares. These workshares are usually guaranteed and sometimes difficult to accommodate. Sweden has offered as much as 200% workshare to Denmark if they purchase the Grippen fighter (43:1). The reason Sweden offered so much is that some nations put work content and jobs above system capabilities, picking the program that can offer them the most work (19:1). The work shares are usually included in either direct offsets or indirect offsets. Currently, U.S. laws and regulations do not allow the U.S. Government to enter into an offset agreement with another country. The U.S. leaves the negotiation and implementation of offset agreements to the contractor. For most of the countries that the U.S. enters into a cooperative agreement, the government negotiates and implements the offset agreements (39:1). Mr. Durando adds that as "the prime contractor is forced to give away

more and more work and responsibility, control commensurate with the responsibility of a prime contractor is difficult to retain" (16:1). Several other difficulties and hindrances were brought out in the interview process. Following are some not discussed above:

- Cooperative programs have a slow administrative process (10:1).
- Approval of third country sales due to technology and proprietary information implications (19:1).
- Difficult decision processes on both sides of the Atlantic, but the European process seems to be more difficult (17:1).
- European planning is not as long range as the U.S.'s (39:2, 30:2).
- "There is a feeling that security is not as tight in Europe" (19:2).
- "U.S. Congressional scrutiny. Congress seems to want many more benefits than just political ones" (43:2).

Lessons Learned that Could Benefit the Agile Falcon Program

Following is a list of lessons learned that were highlighted by interview respondents during their interviews. The lessons learned are separated according to position within the F-16 program (OSD, OASD, SAF, SPO, EPG, and contractor). Some of the lessons learned presented are not plausible or impossible to implement due to laws, regulations, and reality. They are presented to help provide insights into the management and implementation of cooperative programs, drawing on the experience of the people who actually work on an international program.

OSD, OASD, SAF. Recommendations of OSD, OASD, and SAF personnel interviewed follows:

- "In order for cooperative programs to be successful, the partners have to compromise their parochial interests for the good of the whole" (23:1).
- "The cooperating governments should establish objectives prior to involving their respective industries" (23:1).
- "New cooperative research and development programs can save money for the U.S. (30:1).
- "Nothing (in a cooperative program) can be done quickly" (30:1).
- Curtail U.S. fighter cooperative programs. "The U.S. seems to be depending on burden sharing agreements (cooperative programs) that usually do not materialize. This speculation is hurting U.S. programs because we tend to under budget" (26:1).
- When starting cooperative program discussions with prospective partners, do not promise a lot capabilities and benefits prior to formal negotiations. When these promises are not approved, the U.S. loses some credibility (43:1).
- Use a management structure that is not unwieldy. Big, inflexible management structures have been blamed for some cooperative program failures (10:1).
- Set workshare goals rather than having mandatory workshare percentages. Hard and fast workshare requirements have led to some uneconomical ways of doing business in international programs (10:1).

System Program Office. Recommendations of system program office personnel interviewed follows:

- "Insure that there are true requirements prior to negotiating a cooperative agreement for a cooperative program" (39:1).
- If one has to start and plan a coproduction program, use the F-16 MOU as a baseline. It has all of the lessons learned from the F-16 program already incorporated in it (6:1).
- "When planning international programs, allow much longer times for decision making than normal one country acquisitions" (17:1).
- "The stability resulting from international partnerships that allows for multi-year contracting enables a program office to successfully plan and implement the associated plans" (10:1).
- "Involve international representatives in the System Program Office (SPO) in decision making rather than having the steering committee participate in day-to-day decisions" (17:1).
- "Accept the SPO obligation to continuously generate and serve up new ideas and options for steering committee review" (17:1).
- Find a way by implementing a new law or regulation to get the U.S. Government involved in the offset arrangements and commitments. Currently, it is left to the U.S. contractor to negotiate and guarantee offsets. Since offsets have a direct impact on program cost, all participating governments should be involved (39:1).
- "Try not to enter into offset agreements, the Commerce and State Departments perceive this as giving away work" (22:1).

European Participating Government. Recommendations of European Participating Government personnel interviewed follows:

- Try to negotiate international armaments agreements without interference from national rules and change or gain waivers to current laws and regulations after the negotiations are complete (45:1).
- When setting up a cooperative program ensure that all partners have equal status and that there are no hidden agendas (8:1).
- Increase the involvement of the international partners in the day-to-day management of the program. This requires additional people allocated to the program from the partners (28:1).
- Management personnel of the lead partner should understand that any of the participants could be the lead nation. This will help the lead nation understand the difficult and sometimes helpless positions that the follower nations can experience (7:1).
- "One hundred percent offset compensation for aircraft buys in a coproduction program are difficult to achieve" (45:1).
- "Keep all of the partners informed and keep communication open among the partners at all levels" (8:1)
- "As costly as big systems are, we have to cooperate to afford the most effective system" (7:1)

Contractor. Recommendations of contractor personnel interviewed follows:

- Implement a program with centralized control from the lead government and the lead contractor. "Democratic leadership will not work" (16:1).

- "Involve potential industrial partners early on in a program", but agree to a discrete task description to insure that the partners have duties and responsibilities (31:1).
- "Allow an inordinate amount of time for the releasability approval process" (31:1).

U.S. and EPG Expected Gains and Losses

Many of the benefits of codeveloping the Agile Falcon, brought out in the interviews, were similar to the benefits of cooperative programs identified in the literature.

All of the U.S. Government personnel interviewed thought the sharing of development costs with the Europeans to gain a new capability was one of the major benefits. Mr. Gissendanner, an OSD Staff Analyst, added that the U.S. would not have even thought about developing the Agile Falcon without European participation since the Advanced Tactical Aircraft (ATA) and the Advanced Tactical Fighter (ATF) are under development (23:2). Additionally, Mr. Brailey, F-16 Technical Director, thought that being able to obtain Nunn money was a good benefit to the F-16 program (10:2). Both Maj General Eaglet and Major Farinelli added that the codevelopment effort would have retained and possibly increased jobs within the F-16 industrial base (17:2, 19:3). Coproduction of the F-16 would have continued past the year 2000 (22:2). Also, the gains in interoperability resulting from the Agile Falcon would be a major benefit. The USAF and European F-16A/Bs (about 1000 aircraft) as modified by the mid-life update would have had similar cockpits and avionics to the Agile Falcon (39:2, 19:3).

The above benefits were generally the same as the benefits found in the literature. Additional benefits would result from the codevelopment of the Agile Falcon. The F-16 has proven to be one of the most capable systems with the capability to be expanded. The Agile Falcon would have contained similar and improved software architecture. This would make it easier to upgrade and retain compatible configurations between the U.S. and EPG aircraft fleets (23:2, 19:3). Mr. Durando of General Dynamics added that the total MLU program cost would have been about 40% less due to some sharing of costs if the Agile Falcon continued codevelopment (16:2). Additionally, Mr. Hempley added that cooperating with the Europeans would have added a beneficial constraint of limiting the aircraft's role to a multi-role aircraft (26:1). Also, the program would have entrenched the EPGs more firmly into the F-16 program rather than the EFA or Rafale (43:2). Additionally, the program would have provided a very capable aircraft for Foreign Military Sales far past the year 2000. Finally, cooperation in an international codevelopment in the 1990s could help U.S. firms do business in Europe when the European economic markets merge in the mid 1990s (31:3).

The EPG representatives interviewed thought the benefits would be an improved capability and increased NATO interoperability while sharing the research and development costs. However, the EPG responses keyed on industrial participation, jobs and participation in the F-16 program past the year 2000 (28:2, 8:2, 7:2, 45:2). Major Vatn emphasized the following: "One benefit would be the involvement in the development of an advanced aircraft. There are very few countries developing and producing advanced aircraft" (45:2).

No losses as a result of participating in the Agile Falcon were identified. Certainly, funds would have been expended and technology would have been transferred. These things are expected in a cooperative program and usually do not constitute a loss.

Technology Transfer

All those interviewed agreed that most of the technology transfer would be one-way to Europe. The EPGs hoped to gain development and manufacturing expertise related to advanced airframe, avionics and engine technologies. Specifically, the Netherlands hoped to attain new composite and man-machine interface technologies (8:2). Norway expected to gain advanced technologies in avionics and aircraft structures (45:2). The Belgians wanted to gain expertise related to blade process technology and subassembly integration for advanced aircraft engines (28:2).

Mr. Durando and Mr. Mayfield of General Dynamics did not expect the U.S. to gain great amounts of technology from the program. However, very high speed integrated circuit and software architecture technology from Belgium and composite fabrication technology from Denmark would have contributed to the program. With or without the Agile Falcon program General Dynamics is exploring these three technology transfer candidates for future applications to the F-16 program (31:3, 16:2).

Since the technology would have been mostly one-way to Europe, some releasability problems could have resulted (6:2). These problems could have been dramatically increased if ATF systems like the engine or some of the avionics were incorporated as OSD wanted. The ATF

technologies most certainly would not have been releasable possibly resulting in two configurations of the Agile Falcon (26:2). However, without the ATF technologies, General Dynamics felt they could have worked the releasability issues resulting in no major technology transfer problems (31:3).

EPG Management Participation

The EPGs extensively participated in the technical requirements definition of the Agile Falcon through the F-16 configuration steering committee (10:2). It was planned for them to become an integral part of the management team in the SPO and at General Dynamics (22:2). Colonel Kennis of Belgium added than an active management role was offered. However, the EPGs would have had to add additional people to the program to take advantage of the offer (28:2). Mr. Mayfield of General Dynamics stated "It was General Dynamics' intent that they (EPGs) would have been involved in every single aspect of the program" (31:2). It would have been up to the individual industries to work out the details of the industrial side of the program since the U.S. Government does not get involved in industrial types of guarantees (26:3). The EPGs have played a key management role in the past on the coproduction of the F-16; there is no reason this would not continue (19:3).

Right Program for Codevelopment

From the point of view of those interviewed, the Agile Falcon is a good program to undertake in a codevelopment effort and it would have been worthwhile for the participants.

From the EPG point of view, it would have been a good program for codevelopment since a successful relationship between the U.S. and the EPGs exists (7:3). Maj Bergsma of the Netherlands thought the following: "It will be a good program for the next generation aircraft when the Europeans have a requirement" (8:3). Since the Danish were not really interested in the aircraft, they thought the Agile Falcon would be worthwhile due to the spinoffs it would generate for updates to their current aircraft (8:3). Major Vatn put it in context with respect to NATO.

> Yes, the Agile Falcon program is the right program to codevelop because NATO needs to work together developing aircraft. It has been the case that Europe likes to work together without the U.S. and may want to continue this in the future. This is not good (45:3).

From the U.S. point of view, the Agile Falcon was the right program for codevelopment because the F-16 coproduction program provided a sound baseline, the Agile Falcon matched the technology available in the participating countries, and the Agile Falcon was not on the leading edge of technology (39:2, 16:3, 17:3, 10:2). Additionally, it was the only aircraft program available and deemed releasable at that time to codevelop with the Europeans (23:2, 19:3). Since it was baselined from an existing aircraft, the program's costs and risks could be minimized (19:3, 17:3). Lt Col Tomeny adds that:

> It would have been a very worthwhile program if the EPGs would have bought aircraft. When it looked like they would not buy aircraft, it did not appear that there would have been enough work for all of the partners (43:3).

All of those interviewed felt that the Agile Falcon codevelopment effort would have been worthwhile. It would have added an increased capability, contributed to NATO RSI, provided jobs to the F-16 industrial base and provided a good aircraft at a reasonable cost.

Effect on European Aircraft Codevelopment

In part, the Agile Falcon was conceived by the U.S. to fill the EPG and possibly other European aircraft requirements well into the year 2000. This put the Agile Falcon into direct competition with the European Fighter Aircraft (EFA), the French Rafale, and the Swedish Grippen which are vying for the European market. The Agile Falcon would have had some effect on those ongoing programs. Certainly the Agile Falcon would have provided the Europeans an alternative that is cheaper than the three European programs (23:3, 43:3, 22:3, 7:3). The Agile Falcon was projected to cost $20 million per aircraft versus $40 million for the Rafale and $45 million for the EFA. The French and the Swedes both tried to get the Belgians interested in their aircraft prior to initiation of the Agile Falcon (28:3). Cancellation of the Agile Falcon program certainly opens the international fighter market to the three European aircraft programs (6:3, 16:4). Without the Agile Falcon, the U.S. does not have an aircraft codevelopment program to offer European customers (26:3). However, the U.S. can still offer the F-16C/D as either an FMS or a coproduction program.

In the future, the Europeans may question the U.S.'s intentions since the U.S. worked so hard to attract the EPGs to the Agile Falcon program and subsequently cancelled it (31:4). However, it probably will

not preclude future efforts with the EPGs. The EPGs and the U.S. have had a good relationship with the F-16 coproduction program and cooperation on the MLU program continues (23:3, 16:3). If a future F-16 or other cooperative program makes business sense for the EPGs and the U.S., there will be a very good potential for it to occur (31:4). The EPGs probably would like to look at the Agile Falcon program in the future when they determine that a requirement exists (43:3). "However, the U.S. may proceed at some later date without the Europeans, locking them out of possible codevelopment and coproduction activities (39:3).

Cancellation of the Agile Falcon

The F-16 Agile Falcon program was cancelled due to a combination of factors. First, the EPGs did not have a requirement for an aircraft in the mid 1990s since they do not perceive the same threat that is driving the U.S.'s requirements. They were participating in the program to involve their industry, to insure their F-16A/Bs would be updated with the MLU, and to keep the door open for future aircraft buys (7:2, 8:3, 45:3, 28:3). Second, as mentioned above, the U.S., DOD, and the USAF could not agree on the requirements for the Agile Falcon. Third, the U.S. budget could not support another aircraft development. Mr. Mayfield of General Dynamics saw it this way:

> The EPGs were not quick to sign up for the program and commit to aircraft purchases. The U.S. could not see enough aggressiveness from the Europeans to commit scarce resources to the program. The U.S. just has too many new aircraft under development to commit to another program that the EPGs would not commit to (31:4).

Future of Codevelopment

All of those interviewed agreed that participation in NATO armaments cooperation is worthwhile for their nation. Major General Robert Eaglet, F-16 SPO Director at the time of the interviews, caveats the above by adding that cooperation may not be appropriate for all programs. "It does not make sense to have a cooperative program just for the sake of having one" (17:2). Colonel Frans Kennis, F-16 SPO Belgian Senior National Representative (SNR), echoed the responses from the EPG personnel interviewed. "Yes (cooperation is worthwhile), it provides small countries like ours an ability to acquire very good systems at a cost we can afford" (28:4). Major Sverre Vatn, F-16 SPO Norwegian SNR, adds that his country has to participate in armaments cooperation due to the small size of Norway's industrial base (45:1). Mr. Norbert Durando, General Dynamics F-16 Business Manager, put armament cooperation in perspective with respect to the F-16 program. "We have sold over 500 F-16s to the EPGs alone, benefiting NATO by having similar aircraft within five NATO countries and providing a multitude of jobs to the U.S. and EPGs" (16:4). Major Farinelli of SAF/AQI, Cooperative R&D, responded from a military point of view. "Yes NATO armaments cooperation is worthwhile. If you are going to fight a war, prepare for that war by getting NATO the most for the least" (19:5).

A consensus of opinion on the classical benefits of armaments cooperation was found during the interviews. The majority of the people interviewed believe that armaments cooperation reduces an individual

country's research and development expenditures per program, enables efficiencies of scale in production, increases RSI, and provides work within their respective industrial complex. The EPG personnel add technology transfer as a benefit. Although, Colonel Kennis labeled technology transfer as a minor benefit (28:1). Major Vatn acknowledged that at one time Norway had no aerospace experience and that participation in cooperative programs contributed to their current aerospace capabilities (45:2).

Mr. Mayfield and Mr. Durando of General Dynamics view the benefits of armaments cooperation from a company point of view. Cooperation has provided an increased business base and a pool of alternative suppliers for General Dynamics. These "alternative" suppliers from across the Atlantic have helped General Dynamics meet program schedules and provide an increased war-time surge capability (16:2, 31:2). Additionally, Mr. Mayfield thinks the cultural awareness brought to General Dynamics personnel through participation in cooperative programs has helped prepare General Dynamics to compete internationally in the next big era when the European economic communities merge in 1992. Major General Eaglet, Mr. John Brailey, and Mr. Roy Hempley emphasized the benefit of program stability resulting from participation in armaments cooperation. "Stability of a program is a definite benefit for the people tasked to manage it" (10:1). As program director for the F-16 program, Major General Eaglet particularly liked the budget stability afforded to the F-16 program since it was a cooperative program. It allowed the Air Force to enter into multi-year contracts saving millions of procurement

dollars per year (17:2). Lt Col Tim Fessor, F-16 Coproduction Manager, added that the involvement in F-16 coproduction by the EPGs adds aircraft repair capabilities across the Atlantic (22:1).

Additionally, participation in international programs within NATO "fortifies the alliance through teamwork and cooperation, allowing the participants to personally get to know their teammates" (17:2). With benefits come trade-offs. Major Farinelli listed three trade-offs participants in international programs may encounter: 1) Deleting or adding requirements, 2) sharing of management responsibility, and 3) sharing of work (19:2).

Of those interviewed, all but one thought the benefits of armaments cooperation outweighed the drawbacks. Mr. Hempley of OASD is believes the erosion of the U.S. industrial base outweighs the benefits (26:2). Three of the four EPG representatives not only agreed that the benefits outweighed the drawbacks, but they also did not believe there were any major drawbacks or big problems associated with their country's participation in cooperative programs (45:2, 7:2, 28:2). Lt Colonel Fessor agreed that there were no real drawbacks. However, "Some people perceive a major drawback of giving away a lot of technology, when in reality we are not" (22:2). Major Farinelli put it this way:

> Yes, the benefits do outweigh the drawbacks. The process is so hard to do and reviewed so much, if it looked like the U.S. is going to get screwed, someone would stop it (19:2).

Finally, if we do not cooperate the Europeans will go somewhere else to get development and production participation and technical help on new systems (6:1).

A consensus was observed regarding U.S. policy to facilitate armaments cooperation. Most thought that sufficient policy has been implemented or that the U.S. was moving in the right direction. Mr. Durando of General Dynamics did not think there was sufficient policy implemented with respect to the releasability issues, but he did think implementation of current policy was improving (16:2). Mr. Mayfield added: "The Nunn and Quayle initiatives build the environment, funding and policy are OK, but all of the roadblocks are encountered during the execution" (31:2). Lt Colonel Tomeny adds that the Nunn amendment and the Weinberger push were good for cooperation. However, there are very few programs being managed under Section 27 of the Arms Export Control Act (43:2). Major Farinelli agreed that sufficient policy has been made. He thinks that too many new policies are being added and the old policies are being changed too much, making it difficult to know which policy should be applied this week. In fact, there may be too much policy (19:2). Colonel Kennis of Belgium adds that there is sufficient policy but within "The Congress, DOD and USAF there are some people who support cooperative programs and some who do not. There does not seem to be a unified U.S. position" (28:2). Additionally, sometimes policy is added during and as a result of a program. The FSX is an example of Congress making policy as it goes (10:2). Major General Eaglet phrased his answer rather simply. "Good and bad things have been implemented. The good things help of course and the bad things add more constraints. Overall, we are holding our own" (17:1). Major strides towards improving armaments cooperation policy have been taken in the last five

to eight years. Armaments cooperation policy will become more and more important as the U.S. and others experience the effect of current budget climates and are forced to cooperate more (23:2).

Suggestions to Improve NATO Armaments Cooperation

Following are suggestions from those interviewed that may help future cooperative armaments programs succeed.

U.S. Personnel Suggestions. Suggestions of U.S. personnel include:

- Select projects that are large and have the possibility of creating or maintaining many jobs (30:4).
- Gain more support from Congress (43:3).
- Harmonize the requirements more by including and listening to the Joint CINCS and Unified Commanders rather than levying nationalistic requirements (19:5, 23:4).
- Insure that all of the participants understand and recognize that it is difficult to satisfy everyone (6:3).
- Improve, streamline, add flexibility, and assign ownership to the releasability process (31:4, 17:3, 16:3, 39:3).
- NATO needs to concentrate on cooperative system and hardware developments to increase compatibility rather than cooperative standards and specifications that are intended to force compatibility (10:3).

EPG Personnel Suggestions. Suggestions of EPG personnel include:

- Standardize MOUs and agreements to facilitate the cooperative process (8:3).
- When negotiating cooperative programs, have a dialogue less constrained by national regulations and objectives (7:3, 45:3).
- Try to make all partners in a cooperative program equal (45:3).
- "Increase the amount of exchange of information between NATO forces at lower levels" (28:4).
- Publicize the good results of international cooperative programs to gain support and create more awareness (28:3).

VI. Conclusions and Recommendations

Conclusions

The conclusions and recommendations are based on the presented literature review (Chapters III and IV) and the interviews summarized in Chapter V. The purpose of this research effort was to answer the Investigative Questions presented in Chapter I. Each investigative question is presented followed by this researcher's conclusions.

1. What management problems can be expected during the codevelopment effort of the Agile Falcon or of a similar program?

The Agile Falcon program was being implemented similar to the highly successful F-16 coproduction program. A multinational steering committee would have provided direction to the F-16 SPO who would have directed the prime contractor, General Dynamics. As in the coproduction program, the SPO would have had central decision making authority, and General Dynamics would have been responsible to the SPO for completing all of the work. These practices have contributed to successful programs in the past.

Management problems related to system requirements, technology transfer/releasability, differing goals/objectives and differing laws and regulations could have caused management problems during the codevelopment of the Agile Falcon.

Clearly, the U.S. by itself could not agree upon requirements for the Agile Falcon. The EPGs preferred multi-role aircraft emphasizing air-to-air capabilities. The USAF wanted a multi-role aircraft emphasizing air-to-surface capabilities to fill their CAS/BAI

requirements while the DOD had the same preferences as the EPGs. Also, the USAF may have wanted to de-emphasize the Agile Falcon's air-to-air capabilities to protect the Advanced Tactical Fighter from budget reductions.

Technology transfer and releasability of the original systems planned for the Agile Falcon would probably not have been a problem with respect to availability. However, as brought out in the literature and interviews, the process of technology transfer and releasability approval is time consuming and will become more time consuming with participation from the Commerce Department.

Differing goals and objectives may have caused some problems. The U.S. wanted to gain a new aircraft while sharing the research and development costs and to offer a new aircraft to foreign customers to compete with the ongoing European aircraft developments. The Europeans were interested in participating in the program to gain development expertise, technology transfer, industrial work, and to update their existing F-16A/Bs.

Different laws and regulations have caused problems in past cooperative programs. It is difficult to say how they would have affected the program once an MOU would have been signed. The EPGs thought U.S. laws and regulations interfered with the MOU negotiation process causing some management problems. However, the MOU should have accounted for the way business was to be conducted on the Agile Falcon program with respect to the participating countries' laws and regulations.

2. What lessons learned from other cooperative programs could benefit the future Agile Falcon program?

Many lessons learned were documented in the literature review (Chapter III) and in the Findings (Chapter V). Following are some lessons learned from Chapters 3 and 5 that may be applicable to management of the Agile Falcon:

-- Do not push a cooperative program just to have one.

-- Insure that all partners agree with the program's requirements prior to implementation.

-- Compromise nationalistic objectives and parochial interests prior to implementing the program.

-- Divide the work and responsibilities between the cooperating industries in the most economical way or be prepared to increase the program's cost.

-- Workshare percentages should not be deterministic numbers. They should be goals.

-- Provide long term funding for international cooperative programs.

-- Obtain firm commitments for aircraft from the participating partners.

-- Allow much longer times for decision making than normal one-country acquisitions.

3. What could the U.S. and the European Participating Governments (EPGs) gain or lose with the codevelopment of the Agile Falcon?

The U.S. could have gained a new aircraft while sharing the development costs, retained or increased jobs supporting the F-16 program and gained an aircraft to compete for the international market. The EPGs could have gained a new aircraft while sharing the development costs, retained or increased jobs supporting the F-16 program, gained aircraft development expertise and received advanced aircraft technology. No losses except maybe management control and the expected transfer of technology would be experienced by the U.S. The EPGs probably had nothing to lose by cooperating in the program except the monetary cost of participating.

4. What technologies do the U.S. and EPGs expect to gain from the codevelopment and coproduction of the Agile Falcon and what problems may be encountered?

Overall, not much technology would have been transferred to the U.S. from the EPGs. Some composite technology may have been obtained from Denmark and some software technology obtained from Belgium. The EPGs would have gained advanced avionics, engine and airframe development and manufacturing technologies. The main problem that would have been encountered is the releasability process. However, if ATF systems would have been incorporated on the Agile Falcon, major releasability problems would have occurred. The ATF technologies would probably not be available to the EPGs.

5. To what extent would the EPGs participate in the management, technical development, and financial backing of the program?

It is difficult to determine how much the EPGs would have participated since the program was cancelled and the MOU was not completed. The invitation from the U.S. was there for the EPGs to take an active role in the management of the program. However, the U.S. was the lead Nation and General Dynamics was the lead contractor just like in the F-16 coproduction program. The U.S. Government and General Dynamics would probably have had difficulties relinquishing responsibilities that they had on the coproduction program.

Since the EPGs do not have the technological capabilities of the U.S., the EPGs' role in the technical development would most likely have been in the form of following General Dynamics. Since the EPGs would not have transferred an appreciable amount of technology, it would have been difficult for them to lead any development effort.

Financially, as it turned out, the EPGs were willing to back the codevelopment effort and possibly not procure aircraft, while the U.S. elected not to back the development and production program. However, if the Europeans would have shown an interest in procuring aircraft, the U.S. probably would have found a way to back the program financially.

6. Is the Agile Falcon the right program for a large codevelopment effort?

The Agile Falcon would have been a very good program for a large codevelopment effort if the Europeans would have had a requirement for the aircraft. The U.S. and EPGs have a very good working relationship on the F-16 coproduction program, most of the management structure was

in place, the development did not push technology and the baseline aircraft is a very capable aircraft. Also, the Agile Falcon program coupled with the F-16A/B MLU program would have certainly helped increase NATO interoperability.

7. What effect would the Agile Falcon codevelopment have on other current European fighter aircraft codevelopment efforts?

The Agile Falcon certainly would have been a competitor to the EFA, Rafale, and the Grippen in the international fighter market. The Agile Falcon would have had a lesser effect on the EFA since the EFA program consists of four countries, all planning to buy the aircraft. The Agile Falcon would have had a greater effect on the Rafale and Grippen since France and Sweden have not secured foreign customers for their aircraft. Cancellation of the Agile Falcon opens the international fighter market to the EFA, Rafale and the Grippen.

8. Why was the Agile Falcon program cancelled?

Several things contributed to the cancellation of the Agile Falcon program. The program was initiated by OSD rather than the Air Force. Consequently, OSD and the Air Force disagreed on the aircraft's mission. The Air Force did not want the Agile Falcon to interfere with or preclude the development of the ATF. Therefore, the Air Force never really pushed the Agile Falcon. The Europeans did not perceive a need for the Agile Falcon and would not commit to aircraft purchases. Additionally, the U.S. is developing the B-2, ATF, ATA and continuing procurement of the F-16 and F-15. Couple the Air Force's ATF priority, the lack of European requirement, the fact that the U.S. was developing

three new airplanes, and the strict budget environment together, and codevelopment of the Agile Falcon did not make sense. Ultimately, the U.S.'s tight military budget resulted in termination of the program.

If the Europeans would have pushed for the program, funding would have been found to support the program. Interestingly, Israel, Turkey and Korea showed interest in the Agile Falcon but were turned away because the U.S. was giving preference to the EPGs. Most likely the Agile Falcon will happen in some form. It makes logical sense to combine the results of the FSX program, the MLU program and the latest F-16C/D program to form the next generation multi-role fighter.

9. Can codevelopment work for future weapon system acquisitions and will it be the trend in the future?

Codevelopment of weapon systems does not have the best track record. However, the recent success of systems like the Tornado are encouraging. The Europeans have much more experience in codevelopment than the U.S. The benefits of codevelopment are well documented and agreed upon. Countries entering a codevelopment program must put these benefits ahead of their nationalistic goals.

Due to the large and increasing costs of new weapon systems, codevelopment of future weapon systems is a necessity for all of NATO and other U.S. allies. The budget climates of most countries will not allow single country developments in the future. Congress seems to have come on-line in support of future competitive programs. Their actions to date are not overwhelmingly convincing. Congress has been reluctant to provide long term funding, which is vital for international

cooperative programs and they have gotten involved with recent technology transfer issues on the FSX. Finally, if this the trend in the future, the U.S. is going to have to train and retain experienced international program management type personnel.

Recommendations

Since armaments cooperation will continue in the future, funding technology transfer/releasability, and personnel issues need to be resolved.

First, the U.S. pushed very hard to get EPGs to join the Agile Falcon codevelopment program even if the EPGs did not buy the aircraft. Then the U.S. could not financially support the program. This certainly did not send a good signal across the Atlantic. The U.S. needs to find a way to fund and guarantee funding for cooperative programs before the programs are marketed and sold to potential partners.

Second, technology transfer and the releasability process has some problems. The U.S. is not willing to release its front-line technology. If this continues, cooperative programs involving the U.S. will not be at the leading edge of technology, risking program support from the services. The services tend to support and push programs that put the new technologies into action like the B-2 and ATF. Additionally, the process of releasability continues to be a problem. Most of the systems are released but after long delays and many requests from the many reviewers for information. To successfully cooperate, the U.S. is going to have to trust or improve allied security so that advanced systems can

be codeveloped; and the U.S. is going to have to streamline and improve the releasability process, possible giving more responsibility to the services.

Third, not a lot of expertise in international programs is available. Both Mr. Schoettmer, Agile Falcon Program Manager, and Major Farinelli, SAF Cooperative Programs, implied that many times you are on your own as a program manager when implementing an international program. Therefore, increased training and lessons learned books should be demanded by the DOD international program policy makers.

Recommendations for Further Research

Since international cooperation will continue and is a relatively new approach to weapon system acquisition for the U.S., further research in the following areas is recommended.

First, research could focus on the technology transfer/releasability process. A study could look at European security to determine if the U.S. could be more lenient with their technology transfer of advanced systems. Also, the process of technology transfer should be examined to determine if it could be streamlined and improved.

Second, difficulties and lessons learned from other cooperative programs could be consolidated to provide a guide for international program managers. Research to collect and collate this information would be very beneficial to those thrust into international program management positions without prior experience.

Finally, the effect of the Nunn and Quayle amendments on international cooperative programs should be researched. Congress and the policy makers think they have set the table for cooperative programs. However, there does not seem to be very many big cooperative codevelopment efforts.

Appendix A: List of Interviews

Col Ralph Bacue	Director, F-16 International Programs ASD/YPX Wright-Patterson AFB OH 45433
Mr. Kaj Bentsen	Senior National Representative, Denmark F-16 SPO ASD/YPX-RDAF Wright-Patterson AFB OH 45433
Maj Geert Bergsma	National Representative, The Netherlands F-16 SPO ASD/YPX-RNAF Wright-Patterson AFB OH 45433
Mr. John Brailey	Technical Director, F-16 SPO ASD/YP Wright-Patterson AFB OH 45433
Mr. Norbert Durando	Manager, Agile Falcon Business Planning Ft Worth Division General Dynamics PO Box 371 Ft Worth TX 76101
Maj Gen Robert Eaglet	Program Director, F-16 SPO (Former) Assistant Deputy to the Assistant Secretary of the Air Force for Acquisition SAF/AQP Pentagon, Wash D.C. 20330
Maj Mauro Farinelli	International R&D Staff Officer SAF/AQI (Cooperative R&D) Pentagon, Wash D.C. 20330
Lt Col Tim Fessor	F-16 Coproduction Manager, F-16 SPO ASD/YPXC Wright-Patterson AFB OH 45433
Mr. Dean Gissendanner	Staff Specialist, Tactical Warfare Programs OSD/DDR&E-TWP Pentagon, Wash D.C. 20330
Mr. Roy Hempley	Staff Analyst for Tactical Programs OASD (PA&E)/Tactical Programs Pentagon, Wash D.C. 20330

Col Frans Kennis	Senior National Representative, Belgium F-16 SPO ASD/YPX-BAF Wright-Patterson AFB OH 45433
Col Joe Maguire	Staff Officer for the Assistant Deputy Undersecretary of Defense OASD/LA Plans and Resources Pentagon, Wash D.C. 20330
Mr. Dwain Mayfield	Agile Falcon Program Director (Former) Director, USAF Program Development Ft Worth Division General Dynamics PO Box 371 Ft Worth TX
Mr. Greg Schoettmer	F-16 Derivative Aircraft Program Manager F-16 SPO ASD/YP Wright-Patterson AFB OH 45433
Lt Col Terry Tomeny	F-16 Deputy for International Programs SAF/AQPN Pentagon, Wash D.C. 20330
Maj Sverre Vatn	Senior National Representative, Norway F-16 SPO ASD/YPX-RNO Wright-Patterson AFB OH 45433

APPENDIX B: Interview Guide

DATE:

NAME/RANK:

TITLE:

YEARS INT'L EXP:

GENERAL

1. How would you categorize NATO armaments cooperation overall based on current international programs, as successful or unsuccessful? Why?

2. What lessons have been learned from past programs that will make ongoing and future programs better?

3. What are the main difficulties involved in NATO armaments cooperation for the U.S.? The Europeans?

4. What are the main benefits that have been derived by the U.S. from our most recent cooperative programs (F-16, Roland, MLRS, NATO Frigate, etc)? By the Europeans?

5. Do the benefits of participation in NATO armaments cooperation outweigh the drawbacks for the U.S.? For the Europeans?

6. What U.S. hindrances to truly successful NATO armaments cooperation remain? What European hindrances remain?
(National barriers: transfer of technology, industrial capabilities, military needs, culture, language, etc)

7. Is the U.S. Government (Congress, DoD, USAF etc) sufficiently making and/or implementing sufficient policy to facilitate armaments cooperation?

F-16 AGILE FALCON

1. What would your nation (U.S., Belgium, Denmark, Norway or the Netherlands) expect to gain from the codevelopment of the Agile Falcon? Lose?

2. What new technologies would your nation expect to receive under technology transfer resulting from the program? What difficulties could arise?

3. Were (would have/could) the EPGs significantly participating in the management, technical development, and financial backing of the program? How?

4. Is the Agile Falcon the right program to undertake in a large codevelopment effort? Why? Why not?

5. What effect could a successful Agile Falcon have on current and future European fighter aircraft codevelopment efforts?

6. What factors contributed to the cancellation of the Agile Falcon?

7. What effect does the cancellation of the Agile Falcon have on current European fighter aircraft codevelopment efforts? On future cooperative programs involving the U.S. and the Europeans?

8. Most likely there will be some form of a next generation F-16. Does cancellation of the Agile Falcon endanger or will it prevent a future F-16 U.S./EPG cooperative development effort? Why? Why not?

SUMMATION

1. Overall, would the codevelopment of the Agile Falcon be a worthwhile endeavor for the U.S.? The EPGs?

2. What suggestions do you have to improve the NATO armaments cooperation process?

3. Is your nation's participation in NATO armaments cooperation worthwhile?

Bibliography

1. Abshire, David M. "Arms Cooperation in NATO," Armed Forces Journal, 123-6: 66-70 (December 1985).

2. Aeronautical Systems Division, Air Force Systems Command, F-16 System Program Office. Draft Memorandum of Understanding Number 8) between the Governments of Belgium, Denmark, The Netherlands, Norway and the United States. Wright-Patterson AFB OH, December 1988.

3. "Air Force, Navy to Present Upgrade Proposals for F-16, F/A-18 Aircraft," Aviation Weed and Space Technology 128: 22-23 (21 March 1988).

4. Amouyal, Barbara. "DOD Considers Codevelopment of Agile Falcon, Japanese FSX," Defense News, 1, (5 June 1989).

5. Auerbach, Stuart. "Accord Set on Technology Transfer," Washington Post, 24 (13 March 1989).

6. Bacue, Colonel Ralph, Director, F-16 International Programs. Personal Interview. ASD/YPX, Wright-Patterson AFB OH, 5 July 1989.

7. Bensten, Kaj, Senior National Representative, Denmark. Personal Interview. ASD/YPX-RDAF, Wright-Patterson AFB OH, 24 July 1989.

8. Bergsma, Major Geert, National Representative, The Netherlands. Personal Interview. ASD/YPX-RNAF, Wright-Patterson AFB OH, 28 June 1989.

9. Bleakley, Gage A. International Armaments Cooperation: A Case Study of the Modular Standoff Weapons. MS thesis, AFIT/GLM/LSM/88S-4. School of Systems and Logistics, Air Force Institute of Technology (AU), Wright-Patterson AFB OH, September 1988.

10. Brailey, John, Technical Director, F-16 SPO. Personal Interview. ASD/YP, Wright-Patterson AFB OH, 6 July 1989.

11. Briley, Howard. "Consortium Chairman Expects EFA to Dominate World Fighter Market," Defense News, 30 (9 January 1989).

12. Dean, Robert W. The Future of Collaborative Weapons Acquisition. Santa Monica CA: The Rand Corporation, September 1978.

13. Defense Systems Management College. Guide for the Management of Multinational Programs (Second Edition). Virginia: 1987.

14. Department of Defense. International Transfers of Technology, Goods, Services and Munitions. DOD Directive 2040.2. Washington D.C.: Government Printing Office, 17 January 1984.

15. Department of Defense. Soviet Military Power 1987 (Sixth Edition). Washington DC Government Printing Office, March 1987.

16. Durando, Norbert, Manager, Agile Falcon Business Planning. Telephone Interview. Fort Worth Division, General Dynamics Corporation, Forth Worth, TX, 6 July 1989.

17. Eaglet, Maj Gen Robert, Assistant Deputy to Assistant Secretary of Air Force for Acquisition. Personal Interview. Pentagon, Washington DC, 28 June 1989.

18. F-16 Multinational Program. "Steering Committee Arrangement No. 44".

19. Farinelli, Major Mauro, International Research and Development Staff Officer. Telephone Interview. Secretary of Air Force for Acquisition, Pentagon, Washington DC, 21 July 1989.

20. Farrell, Major Michael G. The Boeing 767 Program: A Case Study Related to Success in Managing an International Cooperative Project. MS thesis, AFIT/GLM/LSP/86S-18. School of Systems and Logistics, Air Force Institute of Technology (AU), Wright-Patterson AFB OH, September 1986.

21. Farr, Charles M. An Investigation of Issues Related to the Success or Failure in the Management of International Cooperative Projects. PhD dissertation. University of North Carolina at Chapel Hill, Chapel Hill NC, 1985.

22. Fessor, Lt Col Tim, F-16 Coproduction Manager. Personal Interview. ASD/YPXC, Wright-Patterson AFB OH, 6 July 1989.

23. Gissendanner, Dean, Staff Specialist, Tactical Warfare Programs. Telephone Interview. OSD/DDR&E-TWP, Pentagon, Washington DC, 21 July 1989.

24. Griffin, 1Lt Thomas P. and Maj Charles M. Farr. "The FSX Debate: Implications for Future U.S. International Armaments Programs," Program Manager, 18-4: 2-12 (July-August, 1989).

25. Gunston, Bill. The Illustrated Encyclopedia of Major Military Aircraft of the World. New York: Crescent Books, 1983.

26. Hempley, Roy, Staff Analyst for Tactical Programs. Telephone Interview. OASD (PA&E)/Tactical Programs, Pentagon, Washington DC, 17 July 1989.

27. Hepner, John J. A Case Study of the NATO Identification System (NIS) Codevelopment Program. MS thesis, AFIT/GLM/LSM/88S-34. School of Systems and Logistics, Air Force Institute of Technology (AU), Wright-Patterson AFB OH, September 1988,

28. Kennis, Colonel Frans, Senior National Representative, Belgium. Personal Interview. ASD/YPX-BAF, Wright-Patterson AFB OH, 28 June 1989.

29. Lorell, Mark A. Multinational Development of Large Aircraft. Santa Monica CA: The Rand Corporation, July 1980.

30. Maguire, Colonel Joe, Staff Officer for Assistant Depty Undersecretary of Defense for Plans and Resources. Telephone Interview. C D/LA, Pentagon, Washington DC, 24 July 1989.

31. Mayfield, Dwain, Director, USAF Program Development. Telephone Interview. Fort Worth Division, General Dynamics Corporation, Fort Worth Tx, 7 July 1989.

32. Mecham, Michael. "Congress Advised not to Pressure Allies on Agile Falcon, Hornet 2000," Aviation Week and Space Technology, 128:17 (18 April 1988).

33. Mordoff, Keith F. "European Coproducers Study F-16 Upgrades, Replacements," Aviation Week and Space Technology, 126:214-216 (15 June 1987).

34. Ohman, Nils B. Collaboration in Technology: An Exploratory Study of United States Involvement in International Cooperative Technology Programs. PhD dissertation. University of Texas at Austin, Austin TX, May 1980.

35. "Pentagon Endorses USAF Agile Falcon Codevelopment Plan," Aviation Week and Space Technology, 127:21-22 (19 October 1987).

36. "Pentagon Initiative Triggers New Interest in Joint Ventures," Aviation Week and Space Technology, 127:23. (3 August 1987).

37. Rauscher, Capt Patricia N. An Investigation of Issues Related to Success or Failure in the Management of Commercial International Cooperative Projects Within the Electronics Industry. MS thesis, AFIT/GLM/LSP/86S-63. School of Systems and Logistics, Air Force Institute of Technology (AU), Wright-Patterson AFB OH. September 1986 (AD-A174119).

38. Rich, Michael D. and others. Multinational Coproduction of Military Systems. Sanata Monica CA: The Rand Corporation, October 1981.

39. Schoettmer, Greg, F-16 Derivative Aircraft Program Manager. Personal Interview. ASD/YP, Wright-Patterson AFB OH, 28 June 1989.

40. Silverberg, David. "Report: NATO Still A Long Way from Standardization, Cooperation". Defense News: 56 (20 March 1989).

41. Spreen, Wesley. International Cooperation in the Aerospace Industry: Objectives, Structure, Performance. PhD dissertation. Universite Catholique de Louvain, France, 1986.

42. "The Changing Scene, Foreign Military Sales and Technology Transfer," Proceedings of The Seventh Annual Executive Seminar on International Security Affairs. Washington DC: American Defense Prepardness Association, March 1983.

43. Tomeny, Lt Col Terry, F-16 Deputy for International Programs. Telephone Interview. SAF/AQ, Pentagon, Washington DC, 7 July 1989.

44. Trice, R.H. "International Cooperation in Military Aircraft Programs," AIAA/AHS/ASEE Aircraft Design, Systems and Operations Conference. Seattle, Washington, July 31, 1989.

45. Vatn, Major Sverre, Senior National Representative, Norway. Personal Interview. ASD/YPX-RNO, Wright-Patterson AFB OH, 28 June 1989.

46. Weinberger, Casper W. "The Technology Security Program." A Report to the 99th Congress, Second Session. Washington DC, 1986.

47. Zastrow, Wilfred E. The Two-Way Street: U.S./European Armaments Cooperation Within NATO. National War College, Washington DC, March 1985 (AD-B093428).

VITA

Captain Clay R. Frasier was born on [redacted] in [redacted]. He graduated from [redacted], [redacted], in [redacted]. He received a [redacted] from the [redacted]. Captain Frasier entered [redacted] his commission in the [redacted] on [redacted]. His first assignment took him to [redacted] where he was a [redacted]. In [redacted] he joined the [redacted]. He remained at the [redacted] until entering the [redacted] in [redacted]. Captain Frasier is married to the former [redacted] of [redacted]. The Frasier's [redacted] and another child due in [redacted].

Permanent Address: [redacted]

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution unlimited.
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) AFIT/GSM/LSM/89S-9	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION School of Systems and Logistics 6b. OFFICE SYMBOL (If applicable) AFIT/LSY	7a. NAME OF MONITORING ORGANIZATION
6c. ADDRESS (City, State, and ZIP Code) Air Force Institute of Technology (AU) Wright-Patterson AFB, OH 45433-6583	7b. ADDRESS (City, State, and ZIP Code)
8a. NAME OF FUNDING/SPONSORING ORGANIZATION 8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State, and ZIP Code)	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. / PROJECT NO. / TASK NO. / WORK UNIT ACCESSION NO.

11. TITLE (Include Security Classification)
International Armaments Cooperation: A Case Study of the F-16 Agile Falcon Codevelopment Program (Unclassified)

12. PERSONAL AUTHOR(S)
Clay R. Frasier, B.S., Capt, USAF

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
MS Thesis	FROM _____ TO _____	1989 September	97

16. SUPPLEMENTARY NOTATION

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	Armaments Cooperation, NATO, Aircraft, F-16, International
01	03		

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

Thesis Chairman: Craig M. Brandt, Ph.D.
Assistant Professor of International Logistics

Approved for public release: IAW AFR 190-1.

Larry W. Emmelhainz

LARRY W. EMMELHAINZ, Lt Col, USAF 14 Oct 89
Director of Research and Consultation
Air Force Institute of Technology (AU)
Wright-Patterson AFB OH 45433-6583

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT	21. ABSTRACT SECURITY CLASSIFICATION
☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS	UNCLASSIFIED

22a. NAME OF RESPONSIBLE INDIVIDUAL	22b. TELEPHONE (Include Area Code)	22c. OFFICE SYMBOL
Craig M. Brandt	(513) 255-4149	AFIT/LSM

DD Form 1473, JUN 86 *Previous editions are obsolete.* SECURITY CLASSIFICATION OF THIS PAGE

UNCLASSIFIED

The purpose of this research was to examine armaments cooperation within the context of a case study of the F-16 Agile Falcon codevelopment program. The Agile Falcon program involved the U.S., Belgium, Denmark, Norway, and the Netherlands in an effort to codevelop the next generation F-16. The objective of the study was to answer nine investigative questions pertaining to the management, benefits, technology transfer, implementation, effects, and future of the F-16 Agile Falcon program.

This research found that management problems expected during the codevelopment effort would have been reduced since the program followed the F-16 coproduction program. Problems related to system requirements, technology transfer, differing objectives and differing laws and regulations could have caused management problems during execution of the program. The U.S. and EPGs could have gained a new aircraft, retained or increased jobs, and gained an aircraft to compete for the international fighter market. The EPGs could have gained development expertise and received advanced technology. The U.S. did not expect to receive technology from the EPGs.

It appears the Agile Falcon would have been a very good program for a codevelopment effort. The U.S. and EPGs have worked together, the management structure was in place, the development did not push technology, and the baseline aircraft is very capable. The Agile Falcon would have been a competitor in the international fighter market. Cancellation of the program opens the market to the ongoing European programs. The indecision within the U.S. over the aircraft's mission, no European requirement, and tight budgets all contributed to the cancellation of the program.

Recommendations included stable funding for international programs, improvement of technology transfer process, and increased training and documentation of lessons learned should be pursued.